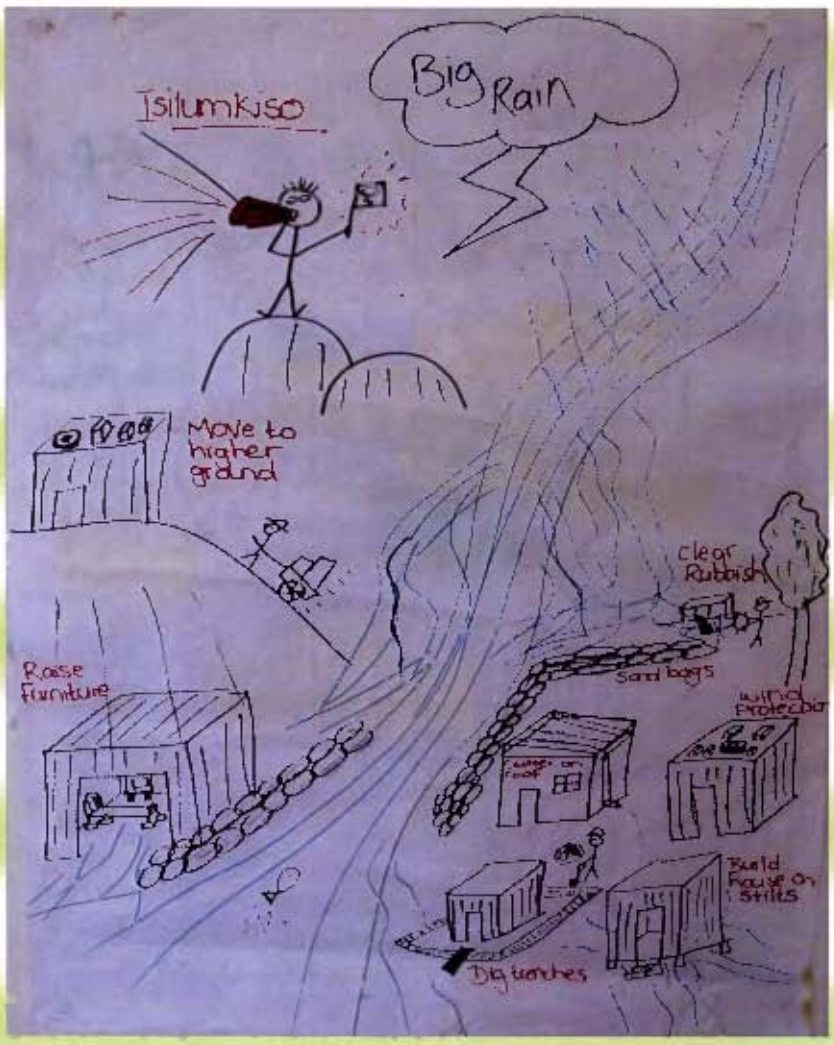
Examining the feasibility of informal settlement flood Early Warning Systems:

Focus on the urban flood-risk experience of Kosovo and Masiphumelele residents, Cape Town South Africa



MPhil Thesis

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Examining the feasibility of informal settlement flood Early Warning Systems:

Focus on the urban flood-risk experience of Kosovo and Masiphumelele residents, Cape Town South Africa

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Master of Philosophy in Environmental and Geographical Science

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By

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DECLARATION

I FJ Solomon hereby declare that this thesis is my original work and that all sources of materials used for this thesis have been duly acknowledged. This work has not been submitted to any other institution anywhere for the award of any academic degree, diploma and certificate or to any other publications.

Signature: _____ Date: _____

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ABSTRACT

Much of the City of Cape Town's (CoCT) urban landscape is characterised by informal settlements, a legacy left by the apartheid regime, with many poor and disadvantaged communities living in areas exposed to the recurrent risk of rising floods. Recurrent flood impacts, during the winter rainfall months, and their costs are disproportionally borne, both by those at risk, and the local government that are required to repeatedly respond to them (Van Niekerk, 2005; UNDP, 2004).

This thesis examines the feasibility of applying people-centred approaches to flood early warning systems (EWS) in informal settlements in the CoCT. It places particular emphasis on the experiences of flood-affected residents living in Kosovo and Masiphumelele informal settlements, in the CoCT. A social science perspective is adopted for this study, with the application of a risk communication framework.

Specifically the study sought to investigate the urban flood-risk context of both study sites, and the risk governance approach to managing and communicating flood risk. In addition, factors influencing flood warning processes, and behavioural factors influencing response to flood-risk and flood warnings were examined.

The methodology used for data collection and data analysis comprised both qualitative and quantitative research methods. A total of 60 households were interviewed using a semi-structured questionnaire, in two pre-selected sites. In addition, one focus group discussion in each study site was facilitated, and key informants of the CoCT were interviewed. Descriptive statistics were used to analyse quantitative data, which was complemented by qualitative data transcribed by the researcher.

The findings of this study suggest that due to a number of challenges relating to prevailing risk communication processes in the CoCT, people-centred flood EWS for informal settlements may be considered impossible or impractical for informal settlement residents affected by rising floods.

The challenges influencing the success of flood EWS include the CoCT's prevailing risk governance approach and conceptualisation of flood-risk and flood warnings, as well as opportunistic behaviour, revealed by informal respondents, in response to rising floods.

Research findings indicate that informal households value their assets and will make creative adjustments to protect them during a flood event. Therefore a flood EWS centred on these needs may be applicable, if all other challenges are overcome.

The results underline a need for greater understanding of the level of flood-risk community members are prepared to pursue, retain or take, and what levels of loss stakeholders are prepared to accept.

ABBREVIATIONS

BRCS	Bangladesh government and Red Crescent Society
CoCT	City of Cape Town
CPP	Cyclone Preparedness Programme
CRA	Community Risk Assessment
DiMP	Disaster Mitigation for Sustainable Livelihoods Programme
DOC	Disaster Operations Centre
DRM	Disaster Risk Management
DRMC	Disaster Risk Management Centre
EWS	Early Warning Systems
IRGC	International Risk Governance Council
ND	No Date
NDMA	National Disaster Management Act
NGO	Non-Governmental Organisation
PCEWS	People-Centred Early Warning Systems
SAWS	South African Weather Service
TEAM	Training, Education, Awareness and Marketing

Research is not important because it finds that certain things are so, that the evidence supports commonly held views, but rather because it establishes that certain things are not so, are different from what is widely believed, and advances new ways of looking at problems. (Quarantelli, 1977).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PICTURES

CHAPTER ONE

INTRODUCTION TO THE STUDY

1.1 Identifying the Problem

The legacy left by apartheid in South Africa is prominent in the existence of severely impoverished and disadvantaged communities who are most at risk to hazards (Van Niekerk, 2005). Due to the continuous expansion of informal settlements in the CoCT, more and more people are in need of space for housing, forcing many people to live in dangerous and hazard prone locations. These factors are further exacerbated by the fact that the poor and marginalised communities living in these areas are likely to live in poor quality housing, and receive inadequate or no public services such as water, sanitation, health and drainage, garbage collection and health services (Abromovitz, 2001; UNDP, 2004). These communities are subject to small recurrent hazards, where the costs of such impacts are disproportionally borne, both by those at risk, and the local government that are required to repeatedly respond to them (UNDP, 2004; Van Niekerk, 2005).

Within the City of Cape Town (CoCT), rainfall during the winter months of May, June, July and August causes recurrent rising floods on an annual basis, particularly in informal settlements. Winter floods compromise public health and safety, cause damage to property, and impacts negatively on livelihoods (Bouchard *et al*, 2007).

In this context, the study examined the feasibility of applying people-centred approaches to the development of new flood early warnings in two of the CoCT's informal settlements.

1.2 Research Aims and Objectives

The study aimed to examine the feasibility of local people-centred flood EWS in informal settlements in the CoCT. It placed particular emphasis on the experiences of flood-affected residents in Kosovo and Masiphumelele informal settlements. Key issues addressed in the study include the flood-risk communication and management approaches and processes in Kosovo and Masiphumelele, as well as the factors that influence both formal flood early warning processes and behavioural responses to flood-risk and flood warnings.

Research findings sought to provide insights on the relationship between local flood EWS and urban flood-risk management in the CoCT. Specific attention was also focused on determining either the effectiveness of local flood EWS in reducing urban flood-risk, or in exacerbating flood and other risk factors.

The specific objectives of the study were:

- Investigate the urban flood-risk context within which informal settlement residents and local government officials reside and work respectively

- Examine risk governance processes with regards to the institutional management and communication of flood-risk

- Examine the factors influencing formal flood warning processes, namely risk assessment, design of risk communication mechanisms and flood warning messages

- Examine the behavioural factors influencing response to flood-risk and flood warnings, namely flood-risk perceptions and attitude/behavioural response

1.3 Ethical Considerations

The following important ethical considerations guided this research:

The researcher ensured the confidentiality and anonymity of CoCT Officials interviewed for this study. The data and information provided by various institutions was referenced in this study.

While the researcher ensured the inclusiveness of respondents to the extent possible, the researcher could not entirely ensure the confidentiality and anonymity of household respondents, particularly in small groups and due to the use of a translator. Best efforts were made to communicate the importance of non-disclosure to the translator, which was diligently repeated to each individual interviewed for the purposes of this study. In addition, the researcher assured the anonymity of individuals providing information during group discussions, while trusting that the other members of the group would practice the same commitment.

1.4 Limitations of the Study

The following research limitations were identified:

Uneven documentation of flood-related data and limited economic flood loss data constrained the compilation of flood records for CoCT informal settlements. As a result, official records relating to the impact of flood events in informal settlements was inconsistent and largely unreliable.

The language barrier between the researcher and informal settlement respondents also constrained the reliability of responses. Although the researcher was able to speak IsiXhosa, aspects of the research were technical in nature, and were therefore difficult to translate and explain in IsiXhosa. However, this was overcome, to the extent possible, during focus group discussions with informal settlement participants who assisted the researcher in acquiring the correct terminology. These were then applied to the household questionnaire.

In addition, study findings cannot be generalised as the sample size was too small to represent the populations of both Kosovo and Masiphumelele, as well as other informal settlement populations.

1.5 Organisation of Thesis

The research paper is organised into six chapters.

The first chapter introduces the study by identifying the problem, and outlining the main aim and research objectives, as well as the ethical considerations and limitations of the study.

Chapter two provides an in-depth review of relevant literature, exploring contributions of the social sciences to the understanding of human behaviour within the disaster research domain, particularly those relating to flood hazards. It also examines the social and implementing dimensions of EWS, focusing particularly on hydro-meteorological early warnings. This chapter also investigates risk governance and outlines the conceptual framework developed for this study.

Chapter three describes the context for the study, providing a brief overview of the global and South African context of the development of Disaster Risk Management (DRM) and EWS. Background information is also provided of urban flood-risk, including the diverse categories of urban flooding,

and the flood-risk context of informal settlements in the CoCT. The chapter also introduces the two study sites, providing a description of each area.

Chapter four describes the methodology used for the collection, analysis and consolidation of data for the study.

Chapter five presents the research findings of the study relating to risk communication processes, the factors that influence formal flood warning processes and the behavioural factors influencing flood warning response.

Chapter six provides a discussion of the risk communication research findings, giving emphasis to the prevailing risk governance model and the implications for flood-risk communication. The chapter also discusses the realised experience of rising floods in informal settlements, and the challenges of implementing flood EWS in these locations.

1.6 Summary

This chapter introduced the study problem and outlined the main aim and key objectives. In addition, the chapter highlighted important ethical considerations guiding the research project, as well as the limitations of the study. To conclude, the chapter provided the organisation for the research paper.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

In recent history societal vulnerability to hazards has increased substantially. This is largely due to changing demographic patterns, increasing number of people exposed to hazards, growth of urban sprawl, poor or unplanned developments and location of individuals and communities in high risk locations (Rodriguez and Diaz, 2004). According to the Millennium Development Goals (MDG) Review Project (Morgan, 2010) by the year 2050 six billion people will be living in towns and cities, moving the locus of global poverty into towns and cities, especially in informal settlements. The rate of urbanisation in Africa is amongst the fastest in the world (DAG, 2006). Urbanisation is increasingly taking the form of informality through expanding unauthorised and unserviced informal settlements, particularly as authorities in towns and cities struggle to meet the service delivery demands of growing urban populations (Ibid; Morgan, 2010).

Vulnerability to hazards plays a role in determining and influencing risk contexts, response to risk, and losses as a result of hazard impacts (Parker *et al*, 2009). The concept of vulnerability is focused on the characteristics of social systems that reduce or exacerbate the impact of a hazard, and not the nature of the hazard itself (Ibid; Oliver-Smith and Hoffman, 2002). Vulnerability conditions, such as socio-economic factors, therefore influence or limit the way in which people behave and respond to warning messages and their willingness to take precautionary measures (Parker, 2008).

While vulnerability conditions have been incorporated into the broad domain of early warnings, the design of EWS largely relies on science, technology and hazard information. Efforts are therefore required to improve knowledge in the study of hazards, and their impact on society, in terms of risk perceptions, mitigation and preparedness, behaviour and response to an event (Rodriguez and Diaz, 2004).

This study therefore assumes a socially nuanced approach to early warnings. It emphasises a better and effective understanding of societal vulnerability, from an interdisciplinary and participatory perspective, where engineers and physical and social scientists work together in an effort to reduce risk in whatever context it exists (Ibid).

2.2 Chapter Overview

Due to the social orientation of this study this chapter explores contributions of the social sciences to the understanding of human behaviour within the disaster research domain. It begins by examining the disaster risk domain as a social science discourse, and how the social sciences have contributed to the better understanding of disasters, particularly those relating to flood hazards.

The chapter continues with a focus on social dimensions of EWS, and how these assist in better understanding and defining human behaviour in response to flood early warnings.

The implementation dimensions of EWS as integral components of risk management are also examined, focusing particularly on hydro-meteorological early warnings. The concept of official and unofficial warning systems is explored and a people-centred approach to early warnings is examined.

This chapter also investigates risk governance as an implicit element underpinning people-centred early warning approaches, and concludes by outlining the conceptual framework developed for this study.

2.3 Theoretical and conceptual shifts in paradigms of the disaster risk discourse

Recent decades have experienced a paradigm shift in thinking around environmental hazards, with an emphasis on natural hazards gradually shifting to an emphasis on disasters, focusing largely on the social production of risk (Furedi, 2007). During the early stages in theoretical thinking, disasters were originally considered 'Acts of God', where disasters were seen as external inevitable events, often requiring structural solutions to protect humans from disasters (Ibid; Smith and Petley, 2007). This was followed by the belief that disasters were 'Acts of nature', bound to occur regardless of prevailing risk contexts, focusing on structural works as interventions for extremes of nature (Ibid). Important outcomes during this time were improved forecasting, early warning and evacuation procedures in disaster prone areas (Smith and Petley, 2007). Eventually, theoretical thinking and conceptualisation of disasters evolved to considering disasters as the result of 'Acts of men and women', where humans are responsible for the occurrence of disasters (Ibid; Furedi, 2007).

The paradigm shift in how we view disasters is reflected in risk management approaches. These approaches embrace the notion that disasters occur at the interface of society and the environment,

and that disaster risk issues are less dependent on natural changes in the environment, but are largely socially constructed (Benjamin, 2008a ; Manyena, 2006; Oliver-Smith and Hoffman, 2002).

Disaster risk is regarded as a transdisciplinary domain as it requires work across disciplines to generate knowledge that better understands and addresses contemporary complexities of context-specific interactions between nature and society (Holloway, 2009; Horlick-Jones and Simes, 2004; Ramadier, 2004; Smith and Petley, 2007). Disaster risk research therefore requires methodologies that transcend pure disciplines for the generation, integration and exchange of information, drawing on methods from different disciplines to form a single approach to assess disaster risk (Horlick-Jones and Simes, 2004). Thus, contemporary approaches and methods of managing risk improve understanding of how disasters are perceived and experienced differently by individuals, thereby assisting in developing effective approaches to reduce varying degrees of risk and vulnerability at household levels (Oliver-Smith, 2002).

2.4 Disaster Risk as a Social Science Discourse

Disaster risk is a prominent topic among many of the sciences, including the natural, social, cultural and economic disciplines. Although each individual discipline fails to completely grasp the entire substance of risk, collectively, they all strengthen both the understanding and management of risk (Renn, 2008 in Benjamin, 2008b, Van der Waldt, 2009).

Disciplines within the social sciences have contributed significantly to present-day understanding of disasters, in influencing approaches to risk management and discovering ways of making responses to risk management measures more effective. Risk professionals have debated whether or not risk is socially constructed or a real phenomenon. Many researchers argue risks and disasters as socially constructed occurrences, influenced by a society's social and cultural norms, values and concerns, and political and economic practices (Oliver-Smith and Hoffman, 2002; Renn, 2008; Rodriguez and Diaz, 2004). It is for this reason disaster risk and associated risk management measures are increasingly studied and understood within the social context in which they occur (Ibid).

This section focuses primarily on the social science perspectives of disasters. How they have influenced the development of risk management measures, such as early warnings, and enhanced the understanding of behaviour in response to these measures.

2.4.1 Contributions of social studies to the understanding of disasters

Sociologists involved in disaster studies were the first to highlight the fact that if individuals perceived a situation to be real, it is real as far as consequences are concerned (Quarantelli, 1994). In other words, the interest of sociologists lies as much in perceived threats as actual impacts of disasters (Ibid). According to Renn (2008), different cultures often have diverse mental representations of what they regard as risk, based on people's perceptions, what people observe in reality, and their experiences, independent of the magnitude and probability of harm. As a result, disasters are experienced in diverse ways by different groups and individuals, thereby generating multiple interpretations of an event (Oliver-Smith and Hoffman, 2002).

Collective behaviour

Sociologists first viewed disasters as the result of social problems or disorganisation, where the break-down of social order or deviant social behaviour sent society into crisis (Quarantelli, 1994). However, this notion was rejected by traditional sociologists in favour of understanding how the environment influences the form of social organisation (impact of disasters) and the creation of new (collective) behaviours that emerge as a result of crisis situations (Ibid; Benjamin, 2008b). Sociologists have therefore given much attention to the collective behaviours of disaster affected individuals and communities (Quarantelli, 1994).

Comfort and Wukich's (2007) research on the collective recognition of risk, undertaken in Northern Sumatra with regards to earthquakes and tsunamis, shows that the degree to which an entire community can take informed, timely action in response to threats depends on the community's capacity for collective recognition of risk. However, in some contexts difficulties may be identified and realised when significant levels of heterogeneity exists within a community exposed to the same type of risk, due to differing degrees of knowledge, experience, resources and capacity for action (Ibid).

Human behavioural patterns in times of crisis

The literature on the sociology of disasters also focuses on human behaviour towards, and perceptions of risk in a disaster, and the unequal social consequences as a result of a disaster (Quarantelli, 1989). Thus, sociologists have given particular focus to documenting the emergence of

behaviours during and after crisis situations (Ibid). However, research has also been undertaken on pre-existing conditions and factors that determine or define peoples' perceptions and behaviours prior to a disaster event (Ibid).

As early as 1977 Quarantelli in his explanation on panic, stated that when people are aware of imminent danger and are threatened personally by it, they will find safety and will generally exhibit adaptive behaviour. Irrational behaviour is therefore rare, and people will respond reasonably and intelligibly to potential threats and associated warnings (Quarantelli, 1977). This argues that individuals at risk will make rational decisions and act in a productive manner to ensure their own safety in the face of imminent disaster. Comfort and Wukich (2007) have subsequently expanded on this view by suggesting that people also have the tendency to employ 'defensive routines' based on beliefs and not on actual facts or information. These beliefs are often constructed from defined past experiences and social contexts, and generally characterise a community's approach to managing risk (Ibid).

Perception of risk: According to research undertaken by Rodriguez and Diaz (2004) in the USA, if people perceive they are at risk of being affected by a severe weather event and the severity of the threat is great, then they would be expected to develop ways in which to reduce loss of life, injuries and damage to property. Those who do not perceive themselves at risk will take little or no action to reduce the impact of a disaster. Depending on conditions and circumstances and perceptions of risk, people may or may not choose to believe they are in danger (Drabek 1986 & 2000 – in Parker, 2008). Consequently, people absorb impacts of extreme events with little or no premeditated action relying on creative adjustments to meet their short and long term needs (Kreps, 1984). Alternatively, formal plans and adjustments are made to distribute risk, modify impacts and prevent disastrous events from occurring (Ibid).

According to Schmuck (2000), increased risk awareness over time may not necessarily incite formal and planned adjustments to reduce risk. In some instances people at risk hesitate to take precautions or evacuate out of an area, even if they recognise or are warned of a pending extreme event (Ibid). For example, people living on Chars in the Jamuna River in Bangladesh are frequently affected by floods, often rendering up to 300 000 people homeless and landless annually (Ibid). Flood victims in this area are perceived externally as helpless, accepting of their fate, passive victims of nature and beyond human intervention. This is largely because Muslims in Bangladesh believe that flood hazards are acts of Allah (Ibid; Haque and Blair, 1992). This is demonstrated by people

living in high flood-risk areas, repeatedly applying moderate 'adjustment' strategies, rather than purposefully undertaking long-term measures to ensure prevention of flooding (Schmuck, 2000).

Such views of passivity by flood-prone communities are however challenged in the literature by Abramovitz (2001), who believes that farmers living along these floodplains have long adapted their housing, landuse patterns and economic activities to these beneficial floods. This is further supported by Comfort and Wukich (2007), who state that communities develop a common knowledge base to recurring risk, which ultimately helps them collectively adapt and protect themselves from recurrent risk.

In short, what counts as a risk to one person, may be an act of God to another, or even an opportunity for an individual or group of persons. Factors influencing people's perception of risk include past experiences, levels of stress, social groupings and circumstances, heuristics and existing biases (Parker, 2008). Diverse perceptions of risk may elicit varying responses by at-risk populations, including denial of risk, and opportunistic behaviour, especially where competing priorities exist among recipients of risk communication (Ibid).

Evacuation behaviour: There is abundant research on human behaviour in the sub-process of flood warning responses referred to as 'evacuation behaviour' (Drabek, 2000). Behavioural research of evacuations in times of potential disaster is extensive as evacuation procedures are commonly used to mitigate negative effects of a variety of disasters (Fischer, 1998). Furthermore, research on evacuation behaviour is vital for better understanding circumstances under which people at risk are willing to evacuate (Ibid).

Studies of evacuation behaviour have attempted to assess factors governing the behaviour of people towards evacuation procedures. Results indicate that a common reason preventing individuals and families from evacuating was concern over their possessions (Ibid). According to studies undertaken by Chowdhury *et al* (1993) and Haque and Blair (1992) of the 1991 Cyclone in Bangladesh, the majority of household respondents stayed at home even after receiving a warning, as they feared their homes would be burgled during evacuation. For these households to lose their possessions it would mean facing worse poverty, more hunger and perhaps death, and would therefore risk staying at home than risk becoming even poorer (Ibid). According to Aguirre's (1991) findings during Hurricane Gilbert in Cancun Mexico, where public services are lacking or poor and public safety and military control is absent, the fear of looting during crisis situations is further exacerbated.

Gender plays a large role in determining an individual's capability and willingness to evacuate. This was highlighted by Chowdhury *et al* (1993), as more women were found to have died than men in the Cyclone that impacted the coast of Bangladesh in 1991. Reasons for this included the fact that women were homebound, responsible for looking after children and valuables at home. In addition, they were restricted in their movements because of the nature of the clothing they were wearing (the saree), and women were physically less able to deal with the process of evacuation as they were generally less nourished (Ibid). Furthermore, in the 1991 Bangladesh cyclone, women found it difficult to evacuate to public shelters as they lacked adequate provision of *purdah* (the practice of concealing women from men) for women (Ibid).

Other factors influencing willingness to evacuate include lower quality of building materials used for housing, which increases the probability of evacuation (Ibid). Additionally, research also shows that poorer people are less likely to evacuate than their wealthier neighbours, even though they are at greater risk to impact by a disaster (Ibid). Experiences in the use of shelters in the past are also influential in determining whether or not people will evacuate in times of crisis. Negative experiences, such as those found in a study of the 1991 Bangladesh Cyclone, include the lack of sanitary facilities and drinking water in shelters, overcrowding and lack of food (Ibid).

2.5 Social Dimensions of Flood Early Warning Systems

Parker's (2008) extensive research on flood EWS in England and parts of Europe, shows how approaches by researchers and practitioners vary considerably according to their different perspectives. Natural scientists, for instance, tend to focus on the technical domains of flood detection, forecasting and routing, as well as on new and improved communication technologies responsible for communicating warnings in the fastest possible way (Ibid). In contrast, Parker (2008) suggests that social scientists tend to use flood warnings as a means to observe, understand and define human behavioural response to flood warnings, identifying and monitoring factors that influence attitudes, perceptions, and experiences (Ibid). The combination of these disciplinary perspectives is useful for the effective design of warnings systems in an effort to improve behaviour in response to them over time (Ibid).

Social research on disasters as early as 1977 (Quarantelli and Taylor, 1977) suggested a tendency to think of EWS as technical or mechanical in nature. For example, more scientific effort has been

placed on the technical development of flood detection and forecasting, and less on flood communication and response to warnings (Parker, 2008). Furthermore research on flood early warnings highlights the common mistake made by designers of early warnings, that passive individuals receive early warnings and respond directly and immediately to them (Parker and Handmer, 1998).

The point often neglected by those designing and implementing early warnings is that early warnings are a means of communication, and their activation, use and purpose are determined by the behaviour and actions of people using them (Parker *et al*, 2009; Quarantelli, 1977). This is further corroborated by Haque and Blair (1992) who suggest that a warning is not a sufficient condition to reduce risk, rather, it is the way people respond to a warning upon receiving it, and why they respond in the way they do, that is important. Therefore, understanding local knowledge, practices and other human characteristics is an important precondition for the successful development and dissemination of EWS (Abiodun and Kotelnikov, 2003; UN/ISDR, 2008; White *et al*, 2004).

Research in disaster situations indicates that situational perceptions of risk and various contextual stimulants cause people to experience and respond to disaster situations in different ways (Parker, 2008). A wide range of social dimensions of flood early warnings influence how and what decisions people make and the mechanisms they employ to facilitate or impede acceptable responses to disasters (Calvo, 2003).

2.5.1 Flood warning receiver and message characteristics

Warnings are never passively received. They are filtered, interpreted and evaluated, and responded too in various ways according to receiver characteristics, message characteristics and the context in which they occur (Drabek, 1999; Parker *et al*, 2009). Furthermore, Parker and Handmer (1998) argue that an important factor determining response to a warning received is the 'situation perception of risk' held by those at risk. This is suggested as an intervening factor between receiving and responding to warnings (Ibid). It refers to how people perceive and define risk they are exposed to and how they decide to respond towards it (Ibid; Quarantelli, 1977). Risk perceptions are defined by varying combinations of beliefs, cultural and ideological factors, experiences, people's imaginations and other social, economic, political and historical factors (Basher, 2006; Quarantelli, 1977; Segreda, 2003).

According to Drabek (2000), disaster research pioneers such as Williams, Quarantelli and Mileti argue that flood warnings may be viewed as psychological functions and networks of social processes and structures, where considerable variation exists in what people hear and believe (Drabek, 2000; Quarantelli, 1977; UN/ISDR, 2004). Furthermore, response to warnings is based on what stimulates people to react, which is dependent on who they are, who they are with, and who and what they hear and see (Drabek, 2000). As a result, variations among populations may result in discrepancies in the response originally intended by a warning message, and the actual response that occurs (Quarantelli, 1977). According to Parker (2008), the acid test for warning systems is whether or not they lead people to undertake appropriate responses to warnings, which make them more secure, save lives and reduce damages caused by extreme events.

Message Characteristics

One of the main limitations of responses to early warnings is the message itself (Drabek, 2000). When messages are relevant, specific and attuned to the needs of those at risk they allow perceptions of risk to emerge that are more likely to activate adaptive behaviours towards imminent threats (Parker and Handmer, 1998; Qurantelli, 1977). For example, if the content of a warning message appears vague, people may search for alternative interpretations, and seize on the vagueness in the message in the hopes of neutralising the threat communicated by the message (Drabek, 1986 & 2000 – in Parker, 2008). To ensure correct response to warnings, people should be educated on the meaning of messages (Kelly, 2003). Furthermore, messages must be formulated using common terminology, even if not technically correct, and in a way that reflects perceptions of the problem (Ibid).

According to the IFRCRS (2009), there are three main factors that maximise the probability that people will take timely and effective actions in response to warning messages. First is the source. Different people have different ideas about who is or is not credible, which may change over time. Second is content, which requires that information be clearly and accurately provided on exactly what people are expected to do, in what period of time, and who should take protective actions. Third is style, where the wording and speech of the warning influences public response. According to Kelly (2003), one must also ensure that assistance triggered by an early warning is actually needed and wanted by the potential victims. An understanding of perceptions, beliefs and needs of at risk populations therefore requires a close link between early warning structures and organisations and those they intend to warn (Ibid).

Receiver Characteristics

Receiver characteristics are the characteristics of individuals that are critical in influencing the way people respond to early warnings. Factors include gender, language, age, ethnicity, credibility of authorities and socio-economic status, which are discussed below.

Demographic characteristics: Age is reportedly an important influencing factor as younger people tend to react more readily and quickly compared to older people, who sometimes feel they have 'seen it all' (Drabek, 2000; Parker *et al*, 2009). Gender may influence responses as men in some areas are less likely to respond to warning messages because of 'macho' behaviour, and tend to have stronger contact with public life outside of the home setting, especially in areas where women are required to stay at home while men leave to work outside of the home (Bateman and Edwards, 2002; Calvo, 2003; Drabek, 2000; Riad and Norris, 1998). Women tend to respond more adaptively to warnings as they generally live at greater exposure to risk and have a heightened perception of risk, particularly as they tend to be involved with activities related to health, education and other care issues (Ibid).

Past flood hazard experiences: According to Parker *et al* (2009), factors influencing response to warnings include people's association with past hazards, such as experience and recency of experience of previous hazards and hazard warnings. Renn (2008) argues the link between risk as a mental concept and reality - and to some extent, one's perception of risk - is created through the experience of actual harm, whether it be loss of life or damage to property and the environment. This is further corroborated by Drabek (1986&2000 – in Parker, 2008) whose research shows that the likelihood of an individual undertaking any adaptive behaviour is considerably enhanced by incidents of past experiences.

This can be elaborated using examples on how people respond to early warnings based on realised risk, and their experiences with certain types of flood events. For example, in parts of Bangladesh, where floods have disastrous impacts on populations, local authorities, organisations and people prone to cyclone and flood-risk have developed local cyclone EWS appropriate for people living in these areas, in order to save lives and minimise damages (Akhand, 2003; De Marchi, 2003). People in Bangladesh now respond more readily to cyclone warnings as they are aware of the dire consequences should they choose not to respond appropriately. On the other hand, in Mozambique,

flooding in the Buzi basin is generally a low and gradual inundation, with very little immediate threat to people's lives (Matsimbe, 2003). As a result, warnings issued by local authorities are often not taken seriously by local communities (Ibid).

However, a study undertaken of the 1991 Bangladesh cyclone by Haque and Blair (1992) shows that many households did not respond to warnings issued by the government. This was reportedly because a cyclone of such a magnitude occurred in the area was as far back as 1960, and had not occurred again since, thereby making people believe that it would not happen again. Furthermore, because individuals had experienced so many false alarms in the past, as many cyclonic storms form over the Bay of Bengal, many individuals question the validity of warnings, and often do not respond to them (Ibid; Chowdhury *et al*, 1993).

Minority groups and poor communities: One of the main receiver characteristics extensively researched is that of minority groups and poor communities. Minorities have the tendency to take fewer actions to reduce their own risk, or adopt adaptive behaviour, as they have less trust in officials and law enforcers (Drabek, 1999; Drabek, 2000; Parker *et al*, 2009; Rodriguez and Diaz, 2004). Furthermore, minorities and groups with low socio-economic status may be socially isolated from formal systems, and therefore less likely to respond in a timely and adaptive manner to early warnings (Drabek, 1999; Drabek, 2000; Parker *et al*, 2009). This is further exacerbated by minorities' perception that they are more at risk than their majority counterparts (Rodriguez and Diaz, 2004).

Socio-economic factors influence how people behave and respond to early warnings. People with a lower socio-economic status often need to protect assets and maintain livelihoods in times of disaster, and often choose not to evacuate in order to protect their assets (Twigg, 2003). Tenure and land ownership, and quality and type of housing and building material influence people's response to early warnings, as those with no secure tenure or land ownership tend not to respond readily to warnings, while those with poor building materials tend to evacuate in response to early warnings (Cutter *et al*, 2003; Parker *et al*, 2009).

Dependence on state welfare: Research in Europe shows that a distorted welfare culture exists where people are compensated for damages incurred during a flood event (Parker, 2008; Parker *et al*, 2009). As a result, concerns were raised that individuals exposed to flood-risk behave in a passive non-responsive manner in response to early warnings (Abramovitz, 2001; Parker, 2008; Parker *et al*, 2009). People believe they will be physically and financially rescued by authorities in times of

emergency, and therefore fail to take precautionary measures before a flood hazard occurs and upon receiving flood hazard warnings (Ibid). Furthermore, improved accuracy and dissemination of warnings may actually cultivate a false sense of security or safety, and this, with a combination of effective insurance plans, may encourage people to live in unsafe locations (Abramovitz, 2001). These factors may therefore lead people to take unnecessary risks (Ibid).

Early warning information and knowledge: Inappropriate or ineffective response to flood warnings may be explained by the fact that at risk populations may not yet have learned the meaning of and how to respond to an early warning (Parker, 2008; Parker *et al*, 2009; Twigg, 2003). There are certain components of flood-risk that people at-risk must understand in order to effectively respond to a flood warning, and any lack of information or comprehension of these components may result in inappropriate or ineffective responses to warnings (Parker *et al*, 2009). These include perceiving and understanding the actual risk of flooding, the meaning of flood warnings of different types, how to access warnings and confirm them, and the most suitable and effective responses to flood warnings (Ibid).

According to Parker *et al* (2009) principles of social psychology may be considered and applied to the development and implementation of early warnings in order to improve behaviour and response to them. These include, compelling people to question their environment and safety by creating uncertainty in the materials and approaches used to communicate and educate the public on flood information and warnings; ensure campaigns target specific audiences i.e. by age, gender and ethnicity; 'learn by doing', where populations at risk to flood events engage in flood-risk management activities and work on solutions themselves along with specialists; and finally, transparency in decision-making processes to enhance individual's trust in the flood warning process (Ibid).

2.5.2 Early warning challenges for social science research

According to Kreps (1984), disaster studies continue to highlight the need for more research on the forms of association within and between populations under threat and on formal warning systems for different types of hazard events. Fortunately, through persistent use and adoption of social science approaches, the number of variables found in disaster research studies that determine whether or not a population will consider early warnings, and take appropriate actions, can be better understood (Rodriguez and Diaz, 2004). These can provide important policy pointers for

improving the reliability of warning processes and in increasing the number of households that need to respond to warnings (Parker, 2008).

Drabek (2000) however, urges more caution in generalising early warning research findings on how people behave towards and respond to warnings. Generic early warning solutions are persistently applied to diverse situations, without thoroughly investigating and documenting risk contexts in a planned or organised manner (Ibid; Segreda, 2003). Segreda (2004) also underlines the absence of a 'how to guide' or global database that one may refer to in attempting to design and apply EWS to specific risk contexts. Similarly, Drabek (1999) argues that a classification scheme into which these study results should be aggregated systematically is still lacking.

It is suggested, therefore, that guidelines accompany the development and implementation of EWS to validate whether or not certain processes are in fact appropriate to given contexts (Ibid). Drabek (1999) specifically calls for the development of a guidance system or database that allows for the aggregation of studies that share common sets of social criteria, which allow future researchers, organisations and other authorities to make decisions based on the specific range of their findings, to relate them to common taxonomic niches (Ibid).

2.6 Early Warning Systems for Hydrometeorological Hazards: Implementation Dimensions

2.6.1 Early Warning Systems

EWS are considered an integral component of risk management, as all those involved in early warnings are in fact dealing with risk, ensuring the protection of lives and property from the probability of a threat (Sejbold, 2003; UN/ISDR, 2004; UN/ISDR, 2006). Management of risk and early warnings involves reducing threats to life, property and the environment, preventing malfunctions in important public and private facilities and infrastructure, and providing the time needed to move people and their personal items to a safe place (Kron *et al*, 2003; Sejbold, 2003; United Nations, 2006; UN/ISDR, 2004). EWS are therefore considered an important measure for reducing disaster losses, and play a critical role in providing information and promoting conditions for social learning to enable coping, adaptation and enhancing resilience (Kron *et al*, 2003; UN/ISDR, 2004; Wang *et al*, 2003; White *et al*, 2004).

EWS provide an opportunity for educating people about hazards, their causes and consequences (Zschau and Kuppers, 2003). In so doing, they provide authorities and opportunity to organise and conduct training on disaster preparedness with communities exposed to risk, as well as undertake development interventions to prevent vulnerabilities in the long term (Ibid). In order for these goals and functions to be reached and fulfilled, EWS cannot be created in isolation by a single agency, but require the involvement and close cooperation and coordination by a number of agencies, organisations and individuals from a range of areas of speciality (UN/ISDR, 2006; Zillman, 2003).

The following section expands on the concept of EWS, reflecting on the development and diversity of hydro-meteorological early warnings, focusing particularly on EWS for flood hazards. The concept of unofficial warning systems is explored, and a people-centred early warning systems approach is investigated and empirical evidence drawn upon to provide examples of its success in certain flood hazard contexts. Finally, an implicit element that underpins people-centred approaches to early warnings, namely risk governance is discussed.

2.6.2 Early Warning Systems and Hydro-meteorological hazards

Hydrological and meteorological hazards vary in temporal and spatial scales, and include all phenomena of the atmosphere, ocean and inland waters that pose a threat to the safety of people and their property and possessions (Zillman, 2003). Therefore, early warnings differ according to the type of hazard and associated lead time available to carry them out (Ibid; Kron *et al*, 2003). EWS for hydro-meteorological events are diverse, well functioning and technically successful, particularly for tropical cyclones, storm surges and floods (Kron *et al*, 2003; Todini, 2003). Modern methods are employed for detection, observation, evaluation and communication of warnings, and provide a sound scientific and technical basis for warning populations at risk of potential threats (Kron *et al*, 2003).

Hydrological and meteorological authorities often work together, as surface hydrological processes largely depend on the timing, intensity and distribution of precipitation and evaporation patterns (Zillman, 2003). Therefore, in many countries, the National Meteorological and Hydrological Services are responsible for collecting and observing national climate record, predicting behaviour of atmospheric and related processes, and providing information, forecasts, warnings and advisories to the general public and specific user groups (Ibid).

In South Africa, daily rainfall maps are developed within a few hours of a rainfall event, using satellite images, radar images and recorded rainfall data (Alexander, 2003). Flood warnings may be determined in three ways, first as a forecast based on meteorological data, which is more long term and is less accurate, second is a flood forecast based on antecedent precipitation, which is moderate and more accurate (Ibid). Thirdly, flood forecasts may be based on gauged upstream river flow, allowing shorter warning times, but greater accuracy (Ibid). Most national flood warnings are developed on major rivers as the lead time allows for vulnerable populations to receive warnings in time to react (Alexander, 2003; Kron *et al*, 2003). As a result, much of the literature on, and empirical evidence found on flood warning systems is based on riverine flooding, with little focus on other types of flooding such as ponding, seepage and slow rising floods, most common in unplanned urban settlements.

Mitigation of flood damage requires a combination of flood preparedness, operational flood management and reconstruction and review once the flood event has passed (Todini, 2003). Flood preparedness activities include investigating causes of flooding, developing contingency plans for potential flood disasters, identifying areas prone to flooding and developing flood-risk maps. Additional preparedness activities involve the construction of flood defences and implementation of forecasting and warning systems, landuse planning and management within the catchment area, and public communication and education on potential flood-risk and associated response (Ibid). Operational flood management activities must ensure detection of possible flood events, forecasting of future flood event conditions, issuing of appropriate warnings to the public regarding severity and timing of a flood, and response by both the public and authorities (Ibid).

Communicating flood-risk through early warnings

According to Parker (2008), three types of flood warnings are recognised. The first is warning through personal observation of environmental signs and changes, often known as self-warning. Observations include rising river levels, dark and heavy cloud formations, heavy rainfall, and observing how others react. Second is warning through the observation by community members and their communication of warnings to others. This type of warning makes use of social networks. The third type of warning is of the formal or official kind, with a sound scientific basis, and disseminated by government officials or other recognised organisations to people exposed to risk. The effectiveness and success of these types of flood warnings depends on recipients' willingness and

readiness to take protective action, which varies widely from place to place and time to time, making it a difficult task for flood forecasters (Zillman, 2003).

Formal/Official Early Warnings: A main source of information responsible for the majority of early warning communications to the public is the media. The media is most influential in how people perceive risk and how they respond to the risk information (Rodriguez and Diaz, 2004). Much technical advancement has been made in communication systems, particularly with regards to the internet and telephonic systems, providing much needed informational advantage to those who have access to them (Ibid). In particular, the internet has led to greater improved communications and greater capacity to communicate with the public (Twigg, 2004).

However, legitimate concerns and questions have been raised about uneven access to the internet and other technologies, especially for minority and poor communities who lack the necessary resources to access these emerging systems (Ibid; Delica, 2003; Rodriguez and Diaz, 2004). Technological advancements may increase the digital divide and information gap between the 'haves' and 'have nots', thereby emphasising inequalities that already exist (Rodriguez and Diaz, 2004; Twigg, 2004). Therefore, according to Yodmani and Hollister (2001), effective application of communication technologies for risk management largely depends on the appropriateness for the social and economic context in which they are applied.

A second issue is the advancement of science and technology in forecasting extreme events, and the increasing difficulty in communicating the meaning of such forecasts and warnings to the public who have to use them (Abiodun and Kotelnikov, 2003; Parker, 2008; Rodriguez and Diaz, 2004; Yodmani and Hollister, 2001). Research shows that representation of potential threats and timely transmission of warnings to the public often fails, resulting in little or no adaptive action by the public, even when scientific information about a potential threat is well documented among scientists (Comfort and Wukich, 2007; Sharma, 2003). According to Nigg (1995), this is caused by inappropriate scientific formulation of warning messages meant for the general public, as information is often technical and confusing to non-scientists, and contains no instructions on how the public or authorities should take adaptive actions to protect themselves.

Unofficial Warning Systems: According to Parker and Handmer (1998), research on flood warning systems has largely focussed on official or formal warning systems designed by scientific and

government organisations to warn people at risk. However, in reality, those at risk often acquire information from less official sources, such as personal networks or personal observation (Ibid).

Unofficial warning systems often develop among individuals and communities prone to frequently and naturally occurring hazards, especially where attributes of a disaster 'sub-culture' have developed (Ibid). Unofficial warnings are often designed by local communities with enhanced psychological preparedness for flood events, through need, trial and error, or emerge through pre-existing networks. These warnings are often triggered and disseminated through the use of local informal information networks, as shown in figure 1, overleaf (Ibid; Parker *et al*, 2009). In some cases, unofficial warning systems emerge due to a lack of instrumentation required for an official system, or when those at risk are not sufficiently satisfied with an existing official warning system (Parker *et al*, 2009).

According to research undertaken in flood prone areas, people at risk monitor environmental conditions to warn themselves of potential flood-risk, whether they receive an official warning or not (Parker *et al*, 2009). This is often the case in areas with a healthy degree of flood awareness and experience, where a reasonable degree of lead time exists, and where a culture of self-protection and preparedness has developed over time (Ibid). According to Alexander (2003), most floods in South Africa are determined by antecedent precipitation indices caused by large area, long duration rainfall, culminating in severe rainfall events. In these flood contexts, communities are able to observe the extent and severity of rainfall and develop their own flood watch systems based on levels of rainfall. These indicators are used by communities to determine the likelihood of floods developing in their area (Ibid). In other research undertaken in Mozambique, communities living in the Boca and Munamicua basins use traditional knowledge to determine when and who are most at risk to flooding (Matsimbe, 2003). These rural communities are known to use traditional means to warn themselves through the interpretation of natural signs, such as the flight of birds, appearance of insects and the positions of the moon (Ibid).

Disadvantages of unofficial warnings are that they are not always as credible as that of an official source, and those not part of an existing network may be excluded – both unintentionally and intentionally. Furthermore, warnings based on onsite observations are of a higher risk due to their tight time margins (Sharma, 2003). Consequently, people do not have enough time to save their property and possessions, and often tend to live on the edge during seasonal flood months, further exacerbating levels of anxiety (Ibid).

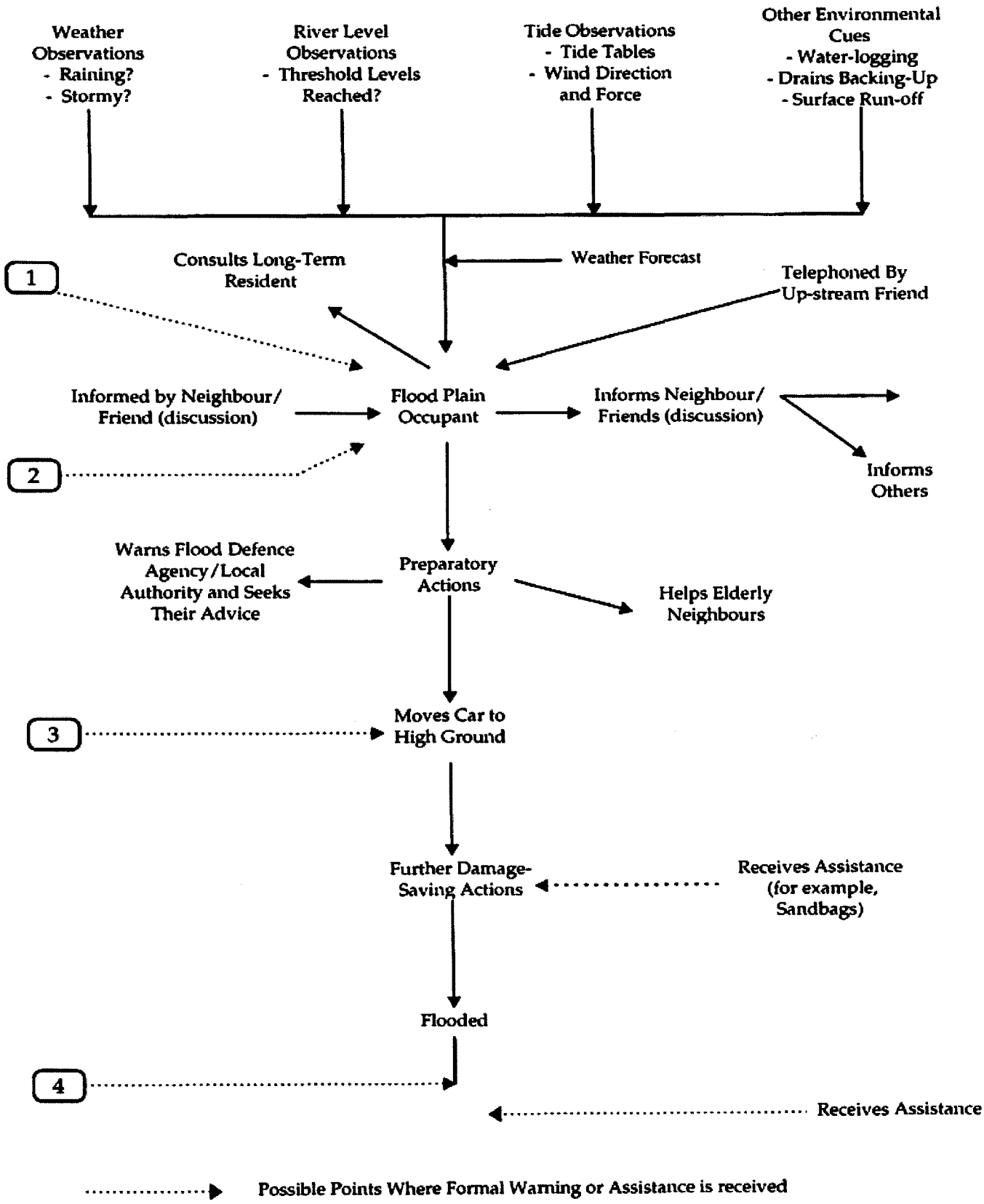


Figure 1: Unofficial Early Warning Systems (Parker et al, 2009)

Flood plain occupants make environmental observations of the weather, and depending on their location, river levels or tidal fluctuations along with other environmental cues. In addition, occupants may receive a weather forecast and or be informed by friends or neighbours of changing conditions. In turn, the occupant may inform others, who themselves inform others in the same situation. In response, the occupant takes preparatory actions, such as informing or seeking advice from local authorities, helping those who have limited capacity or capability, and moving to safer areas. Occupants may then take further actions to reduce flood damage before actually being flooded.

The needs and interests of and general context in which decision makers live need to be understood and included in the process of communicating risk. In particular is the need to meet the requirements of technical issues, social settings and the diverse set of stakeholders involved in the process. According to Corburn (2009), this involves a process of the co-production of knowledge, which contributes towards blurring of divisions, and greater interaction, between science and society and a more collective approach to communicating risk.

2.6.3 People-Centred Early Warning Systems (PCEWS)

A PCEWS approach has been developed and adopted by the international community, in response to increasing empirical evidence demonstrating enhanced and effective behavioural response to risk management measures, due to the application of participatory approaches and integration of risk knowledge (United Nations, 2006). PCEWS emphasise the crucial process of gathering and integrating risk knowledge in a participatory manner (IFRCRS, 2009). This includes both social and scientific dimensions, linking producers and consumers of warning information, for effective, practical and easily understood EWS, based on the needs and perceptions of those at risk (Ibid).

The participatory interrogation and gathering of risk knowledge is vital for understanding complex interactions between nature and society (Galnaraghi, 2009; United Nations, 2006). The PCEWS approach, illustrated in figure 2, overleaf, comprises four key elements – knowledge of the risks faced; technical monitoring and warning service; dissemination of meaningful warnings to those at risk; preparedness to act and response capability (Ibid).

Even though elements seem to follow a direct sequence, they in fact have direct linkages and interactions with each of the other elements (Basher, 2006). Failure of any one of these elements will result in failure in the whole EWS (United Nations, 2006). According to the IFRCRS (2009), if governments make a commitment to support all four elements of PCEWS they will be better able to build appropriate policies and programmes to reduce risk, and enhance sustainable development by building safety and resilience.

Through a PCEWS approach, early warnings can now become a priority at the local level, and become an essential measure for the promotion of a culture of prevention (IFRCRS, 2009; Jeggle, 2003). The first step requires accumulating risk knowledge in databases through participatory risk assessments, mapping and monitoring. This ensures enhanced understanding of risk contexts,

capturing of varying risk perceptions, prioritisation of EWS needs and confidence of adaptive and appropriate response behaviour (Ibid; Twigg, 2003; United Nations, 2006; UN/ISDR, ND).

Secondly, local knowledge is built into technical warning services, complementing and enhancing technical warnings with traditional warning knowledge, while simultaneously providing sound scientific basis for early warnings (Ibid). The third element encourages local authorities and communities to play a role in the communication and dissemination of warnings. In this manner, accountability and understanding of warning messages by those at risk is ensured (Ibid). Lastly, for local actors to be prepared to respond to warnings, they must be acquainted with appropriate actions to take, and believe that by taking these actions they are working towards protecting themselves (Ibid).

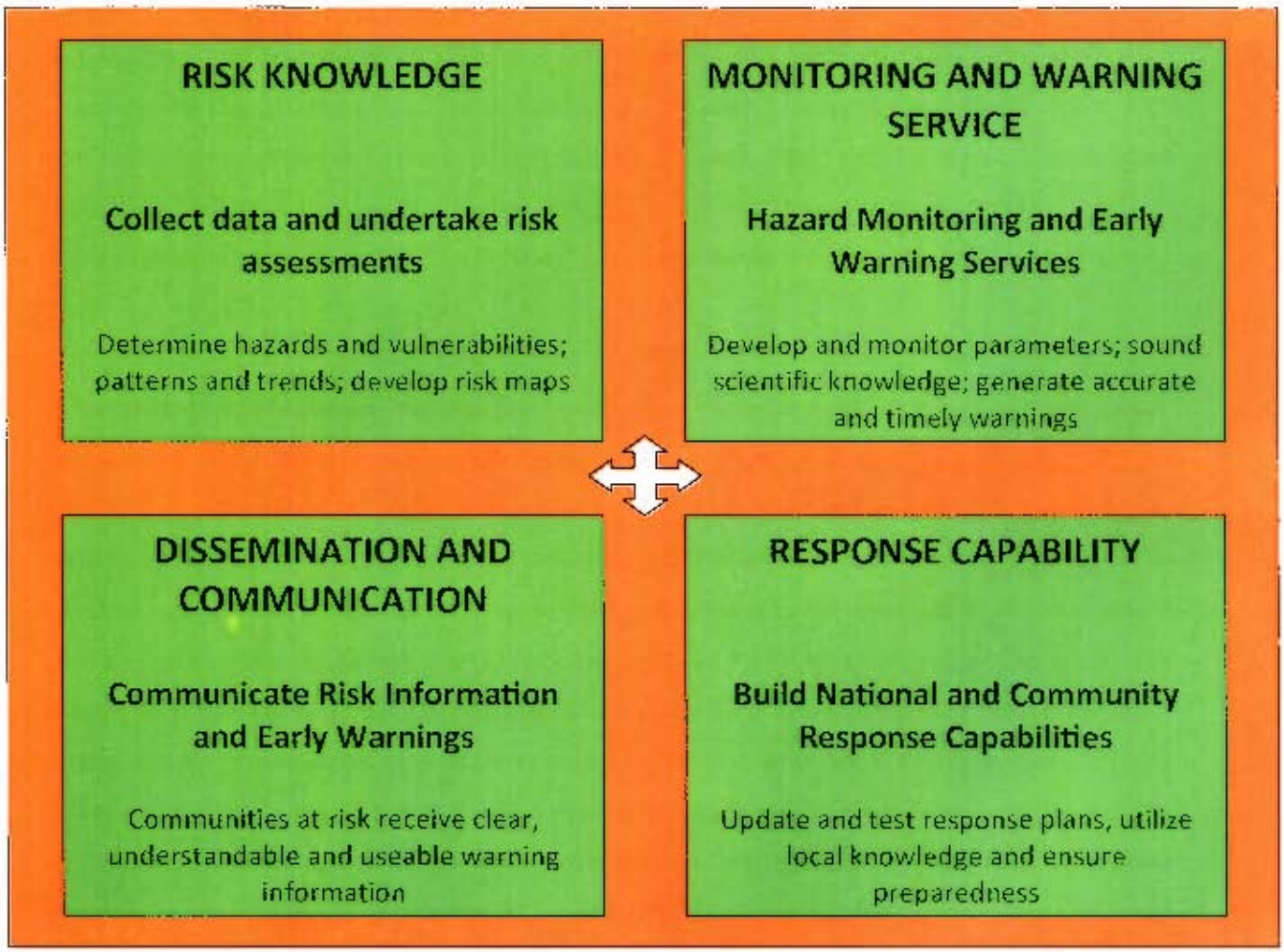


Figure 2: People-centred early warning approach (United Nations, 2006)

Successful examples of PCEWS have been documented where riverine and coastal flooding due to cyclones has had disastrous impacts on populations living in these areas (De Marchi, 2003). For example, a disastrous flood caused by a cyclone in Bangladesh in 1970 reportedly killed 500 000 people (Ibid). As a result, the Bangladesh government and Red Crescent Society (BRCS) helped develop a Bangladesh Cyclone Preparedness Programme (CPP) through community participation in disaster preparedness (Ibid; Akhand, 2003). The goal of this programme is to work together with communities to improve coastal warnings and evacuation in flood prone areas (Ibid).

Local response to warnings in Bangladesh is made possible through recruitment of volunteers. Volunteers are equipped with communication equipment (signal lights and flags, radio receiver, hand siren megaphones), and first aid kits, with the mandate to disseminate cyclone warning signals and assist in evacuation (Akhand, 2003; De Marchi, 2003). To ensure greater awareness, preparedness and knowledge of EWS, the CPP in partnership with the BRCS and other Non-Governmental Organisations (NGO) have developed a Disaster Awareness Programme that targets local populations vulnerable to the impact of cyclones (Akhand, 2003). Disaster awareness raising is undertaken through a number of activities including the production of colourful banners, leaflets, the arrangement of rallies, essay competitions, evacuation demonstrations, short films and training (Ibid).

In Dagupan City, Philippines, flood-prone communities have successfully combined indigenous knowledge with scientific knowledge to develop flood EWS (UN/ISDR, 2008). Flood-prone villages make use of a bamboo instrument, known as a Kanungkong, to relay warning messages to those living along river banks (Ibid). In the past, Kanungkongs were used to assemble village members for meetings, alert people or call children home (Ibid). In addition to the Kanungkong, flood markers have been set up and monitored in key locations in villages, for flood monitoring and as a basis for relaying messages (Ibid). An effective local flood warning system has consequently been developed, making use of warning codes that conform to international disaster warning colour codes, and an agreed upon rhythm and sound of the Kanungkong, corresponding with specific required actions, see figure 3, overleaf (Ibid). In so doing, communities and officials from Dagupan City have successfully ensured the co-production of knowledge through contributions from both indigenous knowledge and scientific inputs, which informed and enhanced all four elements of a PCEWS. This has ensured the uptake and ownership of an effective people-centred flood EWS among flood-prone communities in Dagupan City.

Color	Alert Level	Warning Signal by the Kanungkung
White (Ready)	Normal	
Yellow (Get Set)	Alert (warning, there is danger)	5 strikes of the kanungkung at 20 minutes interval
Orange (Go)	Prepare for evacuation or proceed to holding area (heavy flooding approaches)	10 strikes at 20 minutes interval
Red	Full evacuation (evacuate from homes to designated safe areas) Forced evacuation	Non-stop (15 strikes at 10 minutes interval) Non-stop (20 strikes at 5 minutes interval)
Green	Back to normal	

Figure 3: Local flood early warning system in Dangupan City (UN/ISDR, 2008)

Although the PCEWS is an appealing model, due to its pervasive focus on people and development, unfortunately, there is no 'one size fits all' solution for all contexts (IFRCRCS, 2009). For example, according to the IFRCRS World Report (2009), the Bangladesh CPP volunteer system may not be appropriate in other areas with smaller populations, lower population densities, or other cultural barriers. They also urge caution to ensure the context in which PCEWS are to be applied is thoroughly investigated and understood. One can rarely adopt PCEWS approaches from other country or community contexts and be confident of their success. They must be adapted to the needs, priorities, risk perceptions, social organisation, culture, resources and capacities of local communities and authorities (Ibid).

The PCEWS approach is an operationally oriented system, requiring a conceptually grounded approach to facilitate the execution of all four its elements. This may be achieved through the application of a risk governance framework, ensuring effective execution of and interaction between all four elements of the PCEWS approach. Furthermore, a suitable risk governance framework will enable PCEWS approaches to move toward a developmental space in reducing and managing risk, rather than merely responding to disasters, while bridging the gap between authority figures and those they wish to protect. This will ensure the movement of early warning approaches away from an operational disaster response paradigm, towards a risk and development paradigm.

2.7 Risk Governance

The selection of what is believed to be a risk and how it is managed, according to Renn (2008), is guided by cultural values, institutional and financial resources, and by systematic reasoning. In order to gain maximum value of these guiding elements in identifying and managing risk, the structures, processes and principles of risk governance that ensure collective decision-making must be effectively employed (Ibid).

Risk governance is therefore an implicit element underpinning people-centred approaches to early warnings. To sustain and ensure holistic interaction of the four elements of PCEWS, effective risk governance is required to ensure strong political commitment and support, laws and regulations, durable institutional responsibility and capacities, and transparency and participation (Basher, 2006; UN/ISDR, ND). This section discusses risk governance in relation to EWS, considering its principles, framework and various models.

2.7.1 Risk governance definition and underlying principles

According to Renn (2008), governance describes structures and processes for collective decision-making involving both governmental and non-governmental actors. Furthermore, risk governance may be viewed as the translation of the substance and core principles of governance into the context of risk and all decision making related to risk (Ibid). De Marchi (2003) expands the definition further, maintaining that risk governance may be interpreted as a bridge combining the idea of 'sound' science with democratic participation, where scientific inputs are supplemented by concerns and interests expressed by civil society. Risk governance therefore requires that legal, institutional, social and economic contexts are considered in which risk is evaluated, and involve all the actors who represent them (Renn, 2008).

Risk governance is achieved through the application of five principles of governance (Ibid). First is downward *accountability*, where legitimate problems and priorities of at risk people are identified through their involvement, to reduce their vulnerability (Ibid; Twigg, 2004). Second is *participation* of communities in policy making processes, ensuring their voices are heard, and drafted policies and services provided are socially accepted, making policies and projects more responsive to actual needs (De Marchi, 2003). *Predictability* in risk governance requires a rule based system binding all officials and actors to stabilise expectations of stakeholders and their investment decisions (Ibid). In

order to ensure accountability between policy and decision makers, and for corruption to be prevented, risk governance requires *transparency* (Ibid). Finally, according to Wynne (1996), trust and *credibility* are major contextual factors influencing the uptake and understanding of risk reduction measures and messages, and the public perception of risk.

Risk Governance Framework

Sound risk governance is necessary for the development and implementation of effective EWS that benefit societies, and ensure the minimisation of risk and its consequences. To ensure the application of risk governance principles to risk management measures, the International Risk Governance Council (IRGC) developed a risk governance framework (IRGC ND), illustrated in figure 4. The framework guides risk management in the identification, assessment, management and communication of risk, and ensuring all actors are involved in a participatory and transparent manner at all levels (Ibid). Moreover, the framework adopts a comprehensive approach that facilitates better understanding of risks and their scientific, political, social and economic contexts (IRGC, ND).

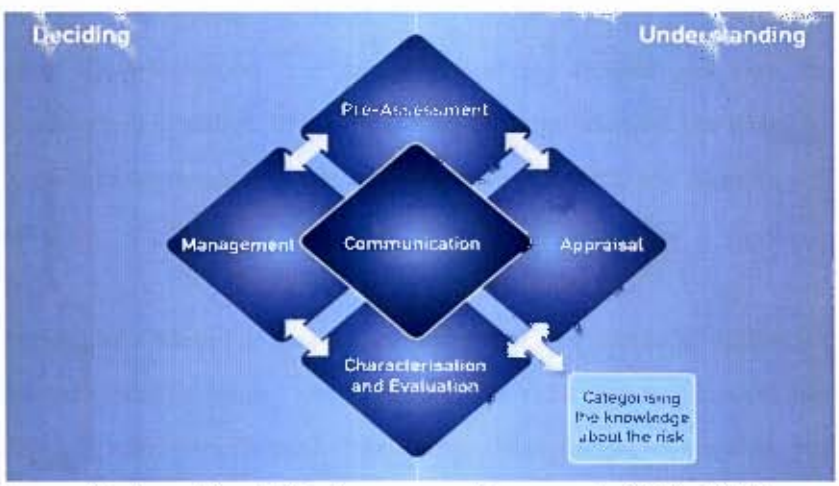


Figure 4: International Risk Governance Framework (IRGC, 2009)

The risk governance framework strives to identify existing or potential deficits within risk governance processes that may prevent those responsible for EWS from achieving a better understanding and appreciation of the societal context of risk (Ibid). Deficits may be found within the five linked phases that comprise the risk governance framework, namely pre-assessment, appraisal, characterisation and evaluation, management and communication phases (Ibid). Once deficits are identified and resolved, better decisions may be made, and more appropriate and

efficient early warning strategies may be implemented, relevant to the needs and interests of communities, and the capacities and capabilities of those implementing them (Ibid).

Paradigms of risk governance models

According to Renn (2008), two types of risk governance are differentiated, namely horizontal and vertical risk governance. Horizontal risk governance consists of all actors in decision-making processes located within a defined geographical or functional segment, such as local or provincial government (Ibid). Vertical risk governance describes the links between these segments, such as actors descending from national to local government (Ibid). The extent to which the vertical and horizontal elements of risk governance engage and intersect, is largely dependent on one of three risk governance models (Ibid).

Technocratic model of risk governance: The 'technocratic' model is where objective science directly informs policy-making, and scientists communicate directly with policy-makers about what they should do (Ibid). According De Marchi (2003), this model represents how members of the public in the past were seen as passive subjects, whose interests and needs were taken care of by experts and public agencies alone, and where knowledge flowed one way, from the knowledgeable to the ignorant and unaware. This model also corresponds with the more traditional EWS approach, where warning systems are at times developed by scientists and experts, with limited engagement with the public.

Decisionistic Model of Risk Governance: The 'decisionistic' model is considered more inclusive than the technocratic model, yet less inclusive than the transparent model of risk governance (Renn, 2008). It considers inputs other than science for policy-making, and other factors, such as socio-political and economic objectives when addressing risk (Ibid). More specifically, risk assessments largely include scientific considerations, while risk evaluation and management take into consideration technical, economic and social information (Ibid).

Transparent Model of Risk Governance: The 'transparent' risk governance model emphasises the interface between risk assessment and management (Ibid). All relevant actors from the sciences, the political arena, the economic sector and representatives of civil society are called upon to play a role in assessing and managing risk (Ibid). This model is more consistent, and proven to be successful with contemporary people-centred participatory early warning approaches. It encourages a two-way

communication flow of risk knowledge and information that enables authorities to implement risk management measures appropriate to various risk contexts, and raise awareness of risk related issues among people living in those contexts.

For effective and inclusive risk governance, stakeholder participation and involvement is crucial. All stakeholders exposed to or whose interests lie in a prioritised risk have something to contribute to the process of risk governance. Their inclusion in the process should be viewed as a means of improving final decision-making, rather than impeding or compromising the decision-making process (IRGC, ND). In some cases though, working with communities is often seen as time and resource consuming and arduous, particularly when dealing with heterogeneous communities with diverse concerns, interests and perceptions of risk (Twigg, 2004). Additionally, stakeholder involvement is sometimes believed to be a 'messy' affair when communities are motivated by self interest and opportunity. This often causes deviations from and disruptions to issues at hand, causing frustrations resulting from endless and possibly fruitless discussions (De Marchi, 2003).

2.8 Conceptual Framework

2.8.1 Overview

The following conceptual framework was developed to assist in interrogating risk governance processes related to the development and management of severe weather EWS and the level of integration of risk knowledge within these systems. For the purposes of this research it also guided the investigation of perceptions and response behaviour of both local risk communication recipients and local government officials, and the level, type and effectiveness of communication processes between local populations and those communicating risk. In so doing, the various elements of a PCEWS approach are included within the framework. This enabled the researcher to explore and examine the repute of these elements within a given risk governance context in the CoCT, to assess the feasibility of developing flood EWS employing a PCEWS approach.

The section first broadly outlines risk communication procedures using an illustrative model. A brief critical assessment of the model is also provided and a framework for this study, adapted from the risk communication model, is presented and described.

2.8.2 Risk communication

In an ideal world, good governance should facilitate processes whereby societies benefit from change while at the same time ensuring that negative consequences are minimised (IRGC, 2009). The same philosophy of risk governance should apply to early warning processes, where the effectiveness of early warnings is enhanced over time through solid political commitment, laws and regulations, durable institutional capacities, and interactive community engagement and participation (Basher, 2006; De Marchi, 2003; UN/ISDR, ND).

A prerequisite for effective risk governance and early warnings is a mechanism for communicating risk information. This is because people at risk need to know about the hazards and risk they face, and how to easily mobilise and protect themselves, while those formally communicating risk require knowledge of risk perceptions, attitudinal or behavioural responses and the needs and priorities of those exposed to risk (Twigg, 2004; Yodmani and Hollister, 2001).

An example of a risk communication model is illustrated in figure 5, overleaf. Communication of risk requires the completion of a comprehensive risk assessment and analysis of data by those responsible for planning, designing and disseminating risk communication (Parker, 2008; UN/ISDR, 2004). Risk communicators then design types of risk communication based on risk data. Risk data includes profile of recipients, how they may be reached, how recipients will best understand risk information, when and how often the recipients are exposed to risk, and the desired behaviour change expected by those issuing warnings (Parker, 2008). The third step in the process involves communicating warning messages via various communication channels to the intended target audience (Ibid).

The target audience consists of a diverse number of individuals and groups depending on their location, social cohesion and class, and other factors such as gender, age, culture, language, education and special needs (Nigg, 1995; Parker, 2008; Rodriguez and Diaz, 2004). They are the risk communication recipients who, upon hearing and receiving a warning message, will attempt to understand, internalise and believe the message, and confirm the message received with others (Blanchard-Boehm, 1998). Following the communication of risk, the target audience will respond and behave according to their perception of risk (Parker, 2008).

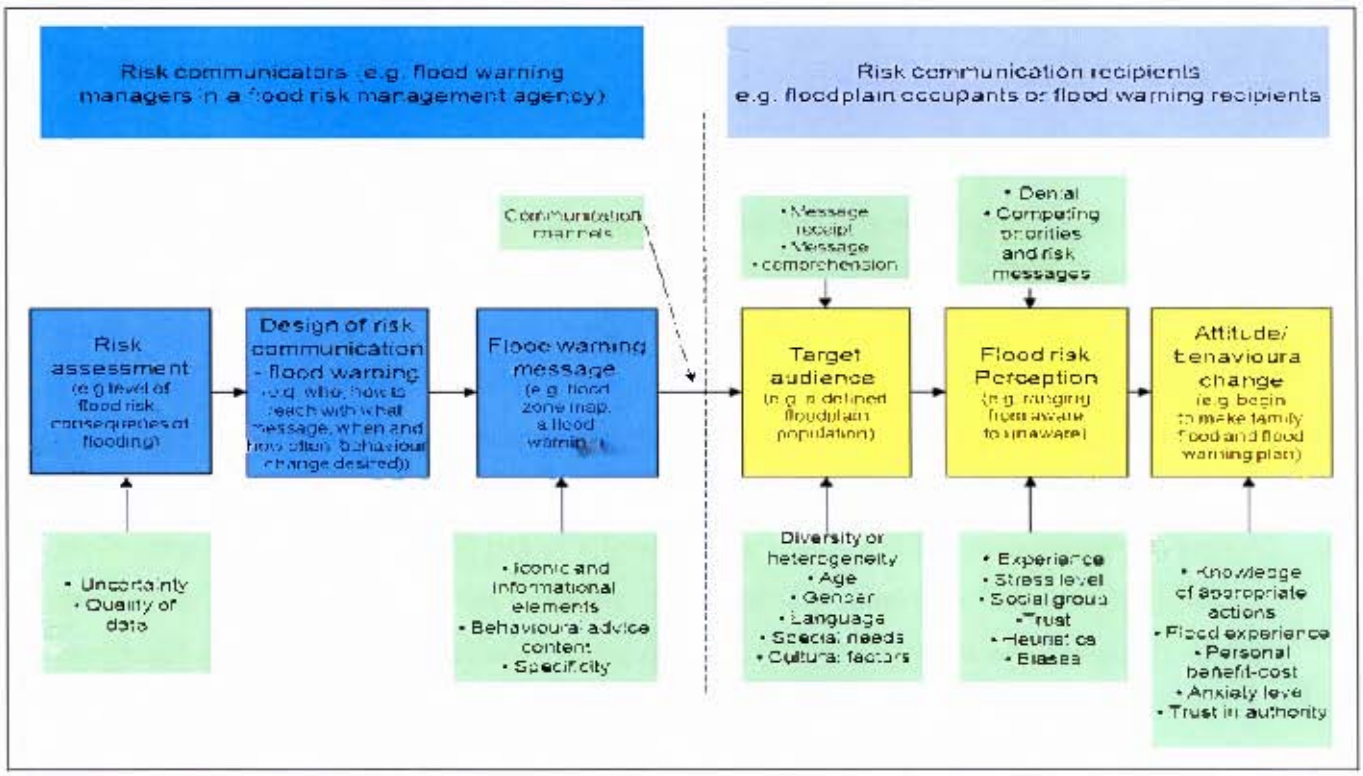


Figure 5: Flood warnings viewed as a process of risk communication designed to influence the perceptions, behaviours and attitudes of risk communication recipients (Parker, 2008)

The final stage of risk communication involves actual attitudinal or behaviour change in response to early warnings (Parker, 2008). From a cultural perspective, Aguirre *et al* (1991) point to the need for either a common shared risk culture, or adaptation of warning systems to multi-cultural social contexts, for warnings to be effective. Within the risk communication process, it is recognised that one is not able to manipulate risk and social factors to ensure correct adaptive actions (Nigg, 1995; Twigg, 2004). However, awareness of such factors allows those disseminating warning messages to include information in warning messages to counteract potential and existing social tendencies, and change counterproductive attitudes and practice (Ibid).

2.8.3 Framework for study

The main aim of this study was to examine the feasibility of people-centred flood early warnings in informal settlements, by assessing factors influencing informal warning processes and behavioural factors influencing flood response. This was done from the perspective of both local government officials and informal settlement dwellers. In addition, the risk governance context in which risk is perceived, realised and managed within the study areas was examined and determined. This required that the study framework adapt the communication process model illustrated in figure 5.

Development of framework

Parker's flood-risk communication model illustrated in figure 5 adheres to the typical flow of standard risk *dissemination* models, following a uni-directional communication chain from 'risk communicators' to 'risk recipients'. The one-way direction of information, indicated by arrows flowing from left to right in figure 5, implies a technocratic risk governance approach in the development and dissemination of risk communication. For example, flood warning managers are responsible for designing flood-risk communication mechanisms and producing content of flood warning messages without proviso for the integration of floodplain occupants' knowledge and perceptions. This is evident in the lack of arrows flowing from the risk communication recipients' quadrant to the risk communicators' quadrant. This is demonstrated even further with the arrow representing 'communication channels' flowing only one direction from risk communicators to risk communication recipients. One may therefore contend that this model be considered a dissemination model, rather than a *communication* model.

This study considers both the biophysical and social experiences of flood-risk, for both informal settlement residents and local government officials, extending beyond the scope of 'typical' warning systems that are historically more meteorologically and technically-oriented. Since flood-risk and warnings are socially constructed and experienced, they are not amendable to conventional approaches to flood early warnings, using linear communication approaches. A strong dynamic social component to a flood early warning approach is therefore necessary to incorporate social dynamics, using an integrated perceptions approach, and focussing on the multi-directional *process* of *communication*. A multi-directional and integrated process of risk communication implies a holistic interaction of the four elements of PCEWS, supported by an effective transparent risk governance model.

Given that an integrated, multi-directional communication process is required for the purposes of this study, the model in figure 5 was modified and adapted to better address the research question, resulting in the development of the conceptual framework illustrated in figure 6, overleaf. Although, a temporal chain of communication is still required, following a logical sequence of communication steps, this approach encourages the communication of alternative views of all stakeholders involved in the communication chain. This is illustrated with the use of vertical and horizontal apposing arrows. Transparent risk governance, required to ensure strong political commitment and support,

laws and regulations, durable institutional responsibility and capacities and transparency and participation, required for effective PCEWS, is illustrated as the light blue area of the framework in figure 6.

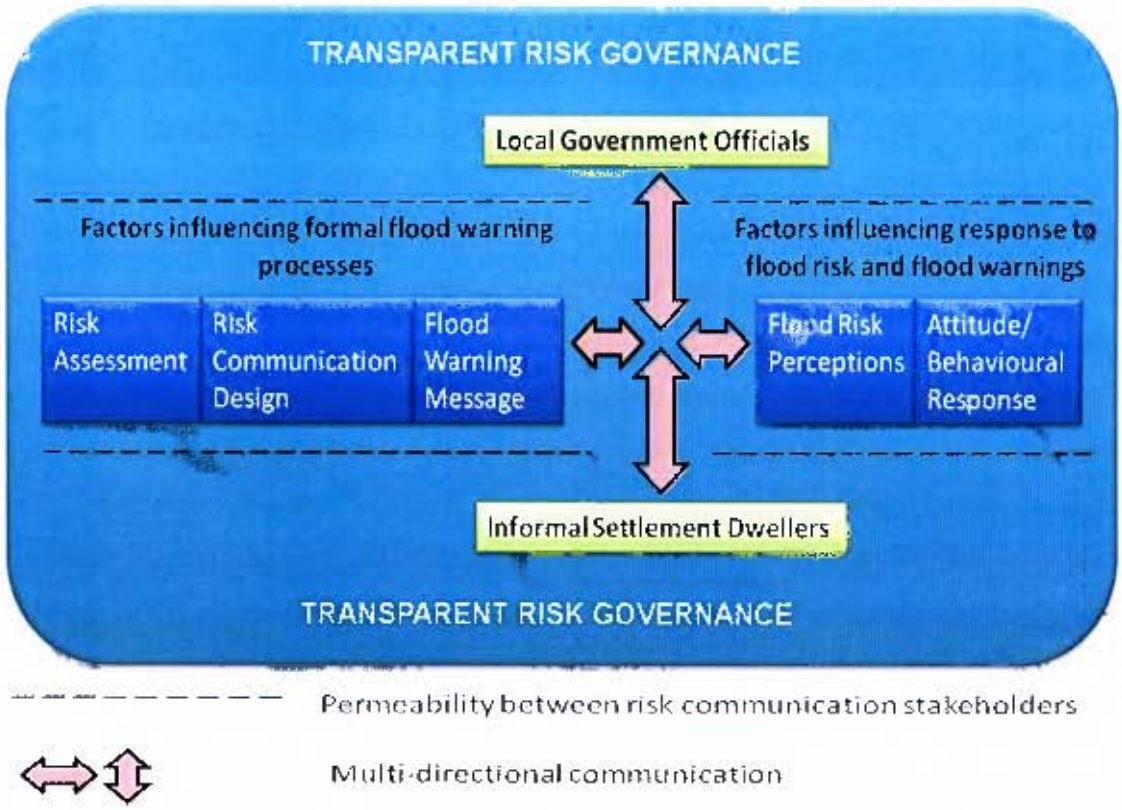


Figure 6: Conceptual framework for the study

Description of framework

Flood early warnings for informal settlements require a two-way communication process, between local government officials and informal settlement dwellers. Allowance must be made for the communication of risk information, perceptions and behavioural patterns between flood-risk stakeholders, as the perceptions and actions of all stakeholders influences the design and implementation of early warnings and the behaviour in response to them. For this reason, the target audience, conventionally viewed as the risk communication recipients, now includes all *flood-risk stakeholders* from both the local government sphere, and those living in communities exposed to flood-risk.

The format of the framework therefore allows for the juxtaposition of factors influencing formal flood warning processes and flood risk perceptions and behavioural response of informal settlement dwellers with those of local government officials. The quadrant on the left of the framework diagram

incorporates the more recognised elements of risk assessment, risk communication design and the flood warning message, of an early warning approach. These *factors influence the formal flood warning process*. The quadrant on the right of the framework includes *factors influencing response to perceived and realised flood-risk*. These include flood-risk perceptions and attitude/behavioural response. All four elements referred to above, within the framework adapted for the purposes of this research project, make up the key elements required for PCEWS.

As noted earlier, the flood-risk communication process does follow a temporal chain of steps, from risk assessment to behaviour in response to a flood early warning. However, the framework used for this study provides for the integration of perceptions, and a multi-directional communication process *between* all flood-risk stakeholders (vertical opposing arrows), as well as between the two quadrants of the framework (horizontal opposing arrows). Knowledge is required of the behavioural factors influencing flood response, as this influences the risk assessment process, design of risk communication mechanisms and the content of flood warning messages. Furthermore, the manner in which risk is assessed, the type of risk communication mechanism used and the nature of the warning message influences the way stakeholders perceive and respond to flood-risk and warnings.

As transparent risk governance is an implicit element underpinning people-centred approaches to EWS (light blue area in figure 6), ensuring multi-directional integrated communication processes, it was necessary to examine and determine the risk governance context in which risk is perceived, realised and managed within the study areas.

The flood-risk warning framework assisted in identifying similar overlapping and different diverging factors influencing the flood warning process as well as behaviour in response to flood warnings, between different flood-risk stakeholder groups. For example, the framework ensured the identification of information suggesting shared or divided perceptions of flood-risk between official and informal flood-risk stakeholder groups. This assisted in determining the relevance of flood early warnings for residents of informal settlements.

To conclude, the conceptual framework developed for and applied to this study allowed the researcher to interrogate findings from the research using prevailing early warning literature. In addition, it enabled the researcher to identify and explore convergences and divergences of the findings with prevailing literature, and the application of the framework to improve future flood-risk management practice and policy.

2.9 Summary

Due to the social orientation of the study, the chapter explored literature pertaining to the contributions of the social sciences to the understanding of human behaviour within the disaster research domain.

The theoretical and conceptual shift in thinking around environmental hazards to an emphasis on disasters, focusing on the social production of risk, was detailed, and the implications for risk management approaches reflected upon.

Disaster risk as a social science discourse was examined, outlining the major the major contributions of social studies to the understanding of disasters. Contributions include theories on collective behaviour and factors influencing human behavioural patterns in times of crisis. In addition, the social dimensions of flood EWS was explored, focusing on the influence of receiver and message characteristics influencing behaviour in response to early warnings.

The chapter continued by addressing literature on the implementing dimensions of EWS for hydrometeorological hazards, introducing the concept of EWS, and expanding on it in relation to hydro-meteorological hazards. The 'official' and 'unofficial' modes of communicating flood early warnings were described, and a PCEWS approach to flood early warning systems introduced and explored.

Risk governance, an implicit element underpinning people-centred approaches to early warnings was examined. Key principles guiding the risk governance framework were outlined and diverse paradigms of risk governance models investigated.

The chapter concluded by critically assessing Parker's risk communication model, and presenting a conceptual framework developed to assist interrogating risk governance and communication processes related to flood EWS. The framework was adapted from Parker's communication process model and drew on prevailing literature on flood early warnings and behaviour in response to flood warnings

CHAPTER THREE
RESEARCH CONTEXT

3.1 Introduction

The informal urban flood-risk context for this study is informed by recent evolution in DRM thinking and by legal and policy frameworks for managing disaster risk, both globally and in South Africa. The chapter examines prevailing categories of urban flooding and provides a background of the flood-risk context in informal settlements in the CoCT. The two study sites are introduced, namely Kosovo and Masiphumelele, and background information is provided on the development history and socio-economic profile of each site. The chapter concludes by describing the CoCT's operational risk management and early warnings approaches.

3.2 Overview of Global and National Progression of Thought in Approaches to Disaster Risk Management and Early Warning Systems

Over the past few decades risk management approaches have evolved due to the emergence and development of a growing interest in socio-economic vulnerability, increased local participation, and the awareness of disaster reduction as an integral component of sustainable development (Van Niekerk, 2005). This has been marked by various proclamations, strategies and frameworks developed and implemented by the international community (Ibid). These include the proclamation by the United Nations General Assembly in 1987 of the years 1990 – 1999 as the International Decade for Natural Disaster Reduction (IDNDR) (UN, 1987) and the articulation of the Yokohama Strategy and Plan of Action for a Safer World in 1994 (Zillman, 2003). Following this was the successor of the IDNDR, the International Strategy for Disaster Reduction (ISDR) at the turn of the century (UNISDR, ND), and the adoption of the Hyogo Framework for Action (HFA) 2005-2015 by the United Nations General Assembly in 2005 (UNISDR, 2005).

As approaches to managing risk have evolved over time, the evolution of EWS has ostensibly progressed at a slower rate. Proclamations and strategies continued to emphasise technical and scientific approaches to EWS. Essentially, neglecting requirements for better understanding the socio-economic vulnerability, social contexts and the participation of local communities in the development and dissemination of EWS. However, in 2005 the HFA highlighted the need to enhance early warnings in its second priority for action, *'Identify, assess and monitor disaster risks and*

enhance early warning', inferring that action needs to be taken on the basis of risk knowledge (UNISDR, 2005). Importantly, the HFA requires that EWS are people-centred, timely and understandable to those at risk, taking into account demographic, gender, cultural and livelihood characteristics of target audiences, including guidance on how to act upon them.

The progression of thought around the management of disaster risk in South Africa has largely paralleled that of global developments and implementation of disaster risk frameworks. Shifts in thinking around the safety of civil society began with the promulgation of the Civil Defence Act 39 of 1966. This was then replaced by the Civil Protection Act 67 of 1977, and finally the National Disaster Management Act (NDMA) 57 of 2002 on the 15th of January 2003 (Van Niekerk, 2005). These changes foreground the importance of developmental risk management and call for greater participatory involvement of at-risk communities and all other relevant stakeholders. This national progression of thought and legislative change of approaches to managing disaster risk is summarised in appendix 1.

3.3 Urban Flood-risk

3.3.1 Introduction

For the purpose of this study, flooding is defined and interpreted from a social constructionist perspective, based on people's experiences and perceptions of floods. This is contrary to a physical science approach to flooding, concerned with the physical nature of floods (Benjamin, 2008c).

3.3.2 Categories of urban flooding

According to Benjamin (2008c) and Douglas *et al* (2008), urban development plays an important role in shaping and exacerbating urban floods by increasing the spatial area of artificial surfaces, and practicing poor landuse, waste and water management. As a result, even moderate levels of rainfall produce high flows of water in urban areas (Douglas *et al*, 2008). Douglas *et al* (2008) suggest four different types of floods affecting urban human settlements, while Benjamin (2008c), deviates from the conventional hydrological model of viewing floods, and includes a further four types of floods, listed in table 1, overleaf.

Table 1: A summary of urban flood types

Type of Flood	Description
Douglas *et al* (2008)	
Localised flooding as a result of poor drainage	Common in unplanned settlements, due to lack of drains or poor waste management. May lead to ponding and overland surface run-off
Small streams	Flooding occurs after heavy rainfall in areas with high antecedent moisture levels, particularly if blocked by debris
Major rivers	Rivers flowing through urban areas are affected by land-use changes, resulting in high flows and flooding
Coastal flooding	Caused either by rising sea levels due to climate change, or storm surges associated with coastal storms
Benjamin (2008c)	
Flooding from wetlands	Dwellings built on the edge of or within the perimeter of wetlands easily flooded during excessive or even normal rainfall
Flood from stormwater channels	Dwellings built on the fringes of stormwater channels, often flooding following heavy rainfall, especially where channels are blocked with debris
Seepage	Flooding where groundwater upwells through floors of dwellings where groundwater tables are high, particularly where solid foundations are lacking
Leaking	Takes place within dwellings where roofs, walls and doors are poorly constructed

3.3.3 City of Cape Town informal settlement flood-risk

Introduction

The CoCT's flood-risk profile is informed by a range of factors, including physical and socio-economic and socio-political factors. This section provides a brief physical and social profile of CoCT informal settlements, including aspects of housing and tenure as well as service delivery.

Physical Profile

The CoCT has mild wet winters, and warm dry summers, characteristic of a Mediterranean climate (Bouchard *et al*, 2007). Cold fronts from the South Atlantic bring stormy weather, heavy rains and strong winds during the winter rainfall months of May, Jun and July (Holloway and Roomaney,

2008). Cut-off lows are also responsible for very heavy rainfall, resulting in severe flood losses (Ibid). The average rainfall per annum for the CoCT is 554 millimetres, with an average of 272 millimetres during the winter rainfall months (Freewater, ND).

According to Bouchard *et al* (2007), the geographical layout of the CoCT and its surrounding areas is one of the primary reasons for flooding in informal settlements. The red circle in figure 7 denotes the location of the Cape Flats (where the majority of informal settlements are found) with significantly lower elevations, explaining recurrent and frequent flooding experienced during the winter rainfall months (Bouchard *et al*, 2007).

Figure 7: Location of the Cape Flats, City of Cape Town (NASA/JPL/NIMA, 2004)

Informal settlements located on the Cape Flats in the CoCT are prone to recurrent and frequent flooding (Holloway and Roomaney, 2008). This is due to their location in wetlands or low-lying areas with high water tables, which usually flood following a rainfall event (Ibid). Other informal settlements are exposed to the threat of flooding due to their location near or within detention ponds, water courses or steep slopes (Ibid).

Most informal settlements in the CoCT do not have formal catchment systems, such as stormwater drainage systems (Bouchard *et al*, 2007). This is largely due to the extreme density of populations and poor layout of settlements, which are unable to facilitate the drainage of surface and ground

waters (CoCT, 2009). Consequently, water accumulates in low lying areas and ground surfaces are persistently soggy (Ibid).

Tables in appendix 2 catalogue the CoCT's flood record from 1996 to 2005, according to the number of individuals and structures reportedly affected by flooding. The records refer to informal settlements affected by flooding in the CoCT and the Cape Peninsula. Unfortunately these tables illustrate poor and inconsistent record keeping and are essentially unreliable. However, they do reflect the annual recurrence of flooding in informal settlements in the CoCT.

Social Profile

According to Small (2008), just fewer than 3.5 million people are estimated to live in the CoCT. Of the population living in the CoCT, a large percentage live in approximately 140 000 informal dwellings, in approximately 230 informal settlements (Armitage *et al*, 2010). The unemployment rate in the CoCT in 2007 was 24.5%, a decrease of 4.7% since the 2001 South African census (Small, 2008). In 2007, 94.4% of all households had access to electricity, 99% to piped water and 92.8% to a flush toilet (Ibid). With regards to refuse removal, just over 95% of households had their refuse removed by the local authority in 2007 (Ibid).

Much progress has been made in the living conditions of people living in the CoCT, particularly as more people are living in formal dwellings (Ibid). However, this has not necessarily reduced the need of many more households living in informal settlements for formal dwellings (Ibid). Issues around housing and tenure, as well as service delivery, are therefore also key aspects in shaping the flood-risk profile of informal settlements in the CoCT.

According to Cross (2006), South Africa's demography of urbanisation is becoming a race for housing. However, the CoCT does not have the capacity or resources to meet the growing demand for housing (Ibid). Consequently, urbanisation is increasingly taking the form of informality, with tenure insecurity being a central characteristic of informal settlements, featuring unsanitary and hazardous living conditions, overcrowding and lack of basic services (Huchzermeyer *et al*, 2006; DAG, 2006).

In response to this however, the first Informal Settlement Upgrading Programme in South Africa was announced in 2005 with respect to the problem of growing informal settlements (DAG, 2006).

Unfortunately though, officials of the CoCT have faced challenges in interpreting and implementing the new informal settlement upgrading policy, particularly due to the lack of a suitable policy instrument and political opposition (DAG, 2006; Graham, 2006). As a result, the CoCT has generally undertaken ad hoc servicing initiatives, largely in response to frequent informal settlement fires and flooding (Graham, 2006).

For a more detailed description of the key challenge posed by housing and tenure, and service delivery refer to appendix 3.

3.4 Research Study Sites: Kosovo and Masiphumelele Informal Settlements

3.4.1 Introduction

This section profiles the two sites chosen for this study, namely Kosovo and Masiphumelele informal settlements, see figure 8. The location, development history and socio-economic profile for each settlement are described, and the flood-risk profile of both settlements is examined.

3.4.2 Kosovo Informal Settlement

Location and socio-economic profile

Kosovo is located within the Philippi suburb, in ward 33 of the City of Cape Town. It covers an area of approximately 27 hectares of land on the low-lying Cape Flats (Armitage *et al*, 2010).

The majority of residents living in Kosovo speak IsiXhosa. It is a large densely populated settlement, with approximately 230 dwellings per hectare (Armitage *et al*, 2010). According to Armitage *et al* (2010), Kosovo has an estimated population of 15 625, living in 6 250 informal dwellings, with a lower than average dwelling occupancy of approximately average of 2.13 persons per household.

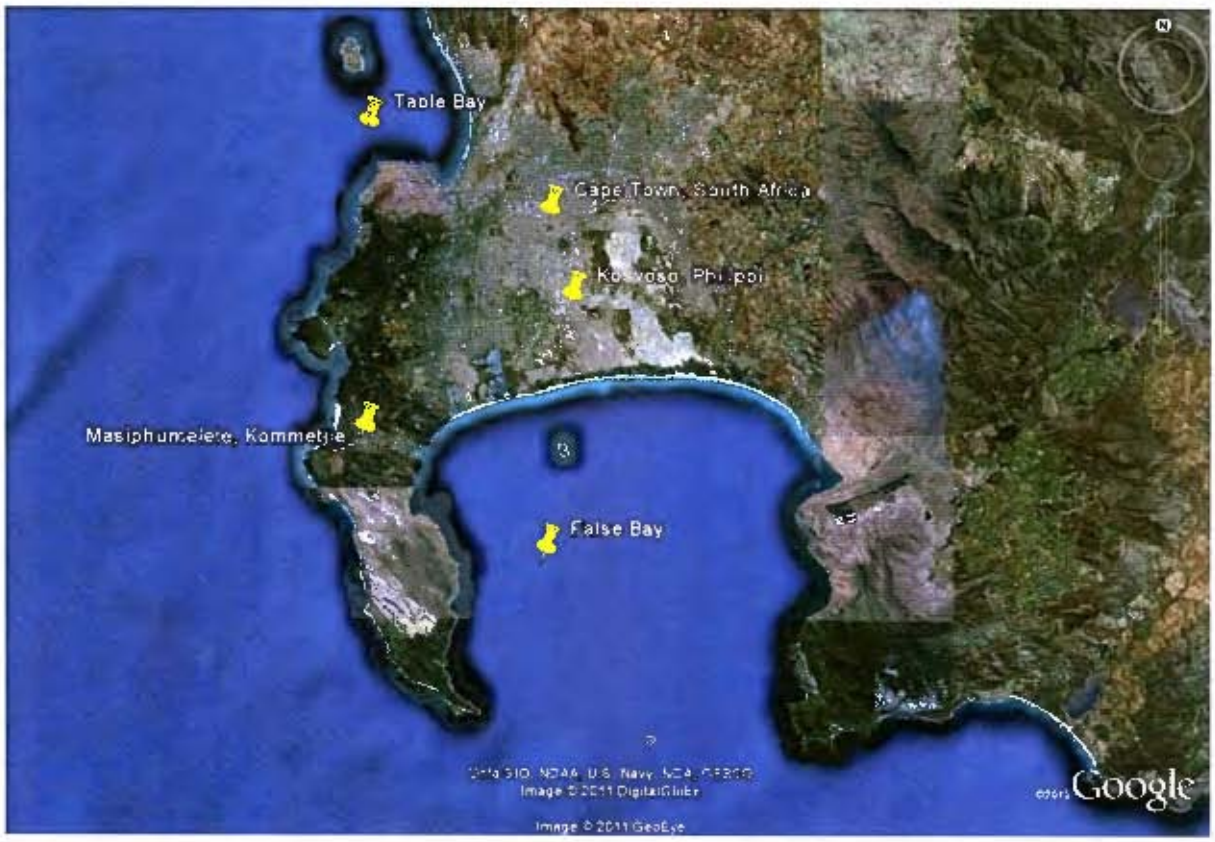


Figure 8: Location of Kosovo and Masiphumelele informal settlements in the City of Cape Town

Many of Kosovo's residents originally come from other nearby CoCT informal settlements, with fewer migrants originating from the Eastern Cape (DiMP, 2009). The age profile of Kosovo residents is relatively young, with majority of individuals between 21 and 40 years of age. The unemployment rate is approximately 51% (Ibid). Those who are employed generally have low skilled and low paid jobs (Ibid).

Development History

The land on which Kosovo is located was privately-owned property covered with dunes and wetland until 1994, and was only home to a few informal residents living on its western border (DiMP, 2009). In 1994 the first planned land invasion occurred and the settlement was named Kosovo, from the war in Kosovo featured in the news at that time (Ibid). A second larger mass invasion occurred in September 2000 (Ibid). As a result, the settlement became very densely populated, as illustrated in figure 9 on page 45.

The CoCT did not initially provide services to informal dwellings in Kosovo as the land was privately owned and fell outside of their jurisdiction (Ibid). As a result, many residents dug their own latrines,

and sought water and electricity from adjacent areas (Ibid). However, population growth in the area resulted in the rapid accumulation of liquid and solid waste, causing a public health crisis (Ibid). Consequently, the private land owners were forced to sell the land to the CoCT (Ibid). This ensured access for the CoCT to provide desperately needed water standpipes, container toilets and refuse skips to residents of Kosovo (Ibid).

Figure 9: Time-series aerial photographs of Kosovo illustrating increasing dens ty from 1998 to 2007 (Source: DiMP)

3.4.3 Masiphumelele Informal Settlement

Location

Masiphumelele is located approximately 40km south of Cape Town, between Kommetjie, Capri Village and Noordhoek, in Ward 69. The settlement is bordered by Kommetjie Main Road to the South, and the Noordhoek Wetlands to the North, see figure 10 on page 48. For the purpose of this research, the focus of the study will be on the Masiphumelele Wetlands to the North of the settlement, as it was in this area that the household interviews took place.

The majority of residents living in Masiphumelele speak IsiXhosa. Population and housing statistics for Masiphumelele are largely inconsistent, however according to the Masiphumelele Corporation and Trust (Masiphumelele Corporation and Trust, ND), various sources estimate the population of Masiphumelele between 20 000 and 30 000. According to the CoCT Disaster Risk Management Centre (DRMC) (2008), Masiphumelele has approximately 171 structures per hectare, in a settlement of 752 informal dwellings. However, considering the estimated number of people living there, this seems a gross underestimation.

Masiphumelele is characterized by high unemployment which is considered to be between 70% and 80% (LivingHope, ND). Those who are employed, work as casual labour, domestic workers or pursue livelihoods in the informal sector (Ibid).

Development history

In 1991/1992 near the end of apartheid, a group of individuals from Khayelitsha moved to where Masiphumelele is today, forming an informal settlement initially designed for 750 families (Ibid). This first settlement of inhabitants was quickly followed by an in-migration of thousands of people from the Eastern Cape seeking employment opportunities in the Western Cape. The community was initially called 'Site 5', but was soon named Masiphumelele, which means 'we will succeed' in IsiXhosa.

During the first years of settlement in the early 1990's it was estimated that approximately 8 000 people were living in Masiphumelele. During these early years residents did not have access to important infrastructure, such as schools and a police station, and services, such as healthcare and

waste disposal. Masiphumelele currently has a clinic, a primary school, one high school and basic services.

Figure 10: Time-series aerial photographs of Masiphumelele in 2004 and 2010

3.4.4 Flood-risk profile of Kosovo and Masiphumelele informal settlements

The main flood-types occurring in Kosovo and Masiphumelele are pooling and overland runoff, largely caused by rainfall and upwelling (Picture 1 and 2). Flooding is mostly due to poor drainage conditions and a high water table close to the ground surface (Armitage *et al*, 2010; DiMP, 2009). Pooling is largely a result of soil saturation due to a combination of upwelling water and heavy rainfall. This is particularly problematic in households that lack suitable foundations - using only compact sand, and that have sunken floors (Ibid). Overland flow of water occurs due to the combination of soil saturation and excess water flowing out of stormwater drains and channels.

Picture 1: An example of pooling in Masiphumelele

Picture 2: Overland flow of water during a flood event in Kosovo 2009

The sub-standard level of housing contributes to the susceptibility of residents to extreme weather and resultant flooding (City of Cape Town, 2008). Many dwellings suffer from leaks and seepage through walls and roofs as a result of poor or limited building materials, which further exacerbate flood conditions inside the dwelling.

Picture 3: Indiscriminate dumping in an informal drainage channel in Masiphumelele

An important factor contributing to flooding is inadequate drainage systems. This is further aggravated by indiscriminate dumping of waste by informal residents (Picture 3). According to community members in Kosovo, this is due to the irregular collection of waste and inadequate provision of waste skips (DiMP, 2009).

Tables 2 and 3 catalogue the flood records for Kosovo and Masiphumelele respectively. Flood records, within the last ten years, were sourced from DRMC's flood records and incident logs and various newspaper articles. These records provide an indication of the recurrent nature of flooding in these settlements year after year.

Table 2: Kosovo flood data for years 2001 - 2009

DATE	DISASTER DECLARATION	AFFECTED STRUCTURES	FLOOD VICTIMS	SHELTER
2001/09/01-05	Y	250	1000	Weltevreden Valley Community Centre
2002/07/24 - 08/21	Y	50 - 200	800	Weltevreden Valley Community Centre
2004/04/09	N	20	80	
2006/08/08		29		
2007/07/25-27		30	520	
2007/08/27	*Flooding reported but no details provided*			
2008/05/9-12		500	1500	Kosovo Crèche
2008/06/21		300	1200	Weltevreden Valley Community Centre; Browns Farm Community Hall
2008/07/04 09		400	3000	
2008/08/31		186	300	
2008/09/03			400	
2009/05/16-29		430	1720	
2009/06/23-24		20		
2009/08/12	*4 Loads of sand provided*			

Table 3: Masiphumelele flood data for years 2002 - 2009

DATE	DISASTER DECLARATION	STRUCTURES	FLOOD VICTIMS
2002/07/02	Y	5	
2004/08/06	*Flood conditions reported, however no data provided*		
2007/07/27			200
2008/07/04-09	*Flooding in Masiphumelele, identified as one of the worst hit areas*		
2008/08/30			2150
2008/09/08		10	35
2008/11/12	*Flood conditions reported, however no data provided*		
2009/05/16		32	120
2009/05/17 18		150	600
2009/07/14	*Flood conditions reported, however no data provided*		
2009/08/18		30	1300

3.5 Operational Flood-risk Management for the City of Cape Town

3.5.1 Overview

This section provides an overview of the management of flood risk in the CoCT's informal settlements. The CoCT Winter Preparedness Strategy is briefly described, and the roles and responsibilities of major role-players outlined. In addition this section briefly examines severe EWS for the CoCT.

3.5.2 City of Cape Town Winter Preparedness Strategy

The CoCT has developed a Winter Preparedness Strategy for a more effective and coordinated state of flood preparedness and response, particularly in informal settlements (CoCT Roads and Stormwater Department, 2009). The Winter Preparedness Strategy is a risk reduction programme and contingency planning approach for potential flooding in areas vulnerable to the impact of flooding (Ibid). The primary aim of the strategy is integrating preparedness and response activities for flood and storm hazards by relevant departments, disciplines, emergency and essential services and external role players (Ibid).

Due to issues of resources and practicality the CoCT is not able to completely eliminate the risk of flooding. However the risk of flooding is managed through planning, design, construction, operation and maintenance of stormwater infrastructure, and development and disaster risk planning. According to Helen Zille (in an interview conducted on Bush Radio in 2007), the Flooding and Storms Plan can only serve to postpone and ameliorate flooding, and then alleviate the suffering as a result of flooding.

Primary role-players on the Flooding and Storms Committee, and whose efforts extend to communities living in informal settlements, include the South African Weather Service (SAWS), Department of Roads and Stormwater, the DRMC and CoCT Communications, Solid Waste Management, Sports and Recreation, the City's Housing Directorate, Social Service Departments and NGO's.

According to a study undertaken by Bouchard *et al* (2007), 25% of 226 informal settlements within the metropolitan area were affected by flooding in 2007, compared to 80% in 2000. This improvement is largely attributed to the upgrading of informal settlements and the CoCT's pro-active cleansing operations, drainage system upgrades and ongoing flood-risk education programmes (Ibid). Furthermore, according to an interview given on Bush Radio in 2008, the City has managed to reduce very high risk flooding areas from more than 30 to just 12 thanks to the relocation of people out of low-lying areas, and flood-risk reduction measures.

3.5.3 Early warning systems in the City of Cape Town

The SAWS has been appointed by the South African Government as the official source of severe weather early warnings, advisories and watches. The SAWS has sole mandate in issuing weather related warnings.

To ensure EWS are effective, principles are adhered to by the SAWS making certain EWS are based on best international practices, are consistent, credible and reliable, and empower the public to act in a timely and appropriate manner to reduce risk. Furthermore, EWS strive to provide relevant information required by decision-makers, with as much lead time as reasonably possible.

The CoCT works closely with the SAWS in implementing early warning systems. In the case of an approaching severe weather event SAWS send a short concise group sms and or email, containing

severe weather early warning information to senior management of CoCT DRMC, Disaster Operations Centre (DOC), Roads and Stormwater Department and other relevant role players. The message is then relayed to response staff involved in the Flooding and Storms Plan. This ensures disaster response teams are on standby city-wide for activation, ready to be deployed to support disaster response and recovery operations. A more detailed description of severe weather early warnings is found in appendix 4.

3.6 Summary

This chapter provides information describing the context of the study. It provided a brief overview of the evolution of thinking of disaster risk management and early warnings on the global and national level. It also discussed the urban flood-risk context of informal settlements in the CoCT, and introduced the two study sites, namely Kosovo and Masiphumelele. The chapter then investigated the management of flood-risk in the CoCT's informal settlements and briefly discussed severe weather early warnings implemented in the CoCT.

CHAPTER FOUR
METHODOLOGY

4.1 Introduction

This chapter details the study methodology which involved a comparative case-study of two flood-exposed and flood-affected informal settlements in the CoCT.

The research design incorporated the collection of secondary data as well as primary data through field research in two sites. Primary data collection specifically involved conducting sixty household interviews in Kosovo and Masiphumelele, the two study sites.

The chapter outlines the process of the secondary data collection, including the types and sources of information used, and description and analysis of the data used. Details on the implementation of the field research are provided in terms of the methods used, the household sample selection process, and the development of the research questionnaires. The chapter concludes by describing the steps involved in consolidating and analyzing data collected from both primary and secondary sources, and summarizing the steps taken in the research process.

4.2 Collection of Secondary Data

A range of secondary data sources were assessed and analysed to better define key issues relevant to this study. These included the review of incident reports, media reports and articles and flood-risk management documents. These sources are summarised and listed in table 2, overleaf.

Table 4: Summary of secondary data sources

Data Source	Document Type	Reason
CoCT Roads and Stormwater Department	Winter Preparedness Strategy	Examine how CoCT prepares for and responds to flooding and storms risk during winter
		Review flood-risk ranking of informal settlements in the CoCT
		Examine South African Weather Service risk communication strategy
	Communication Plan	Examine the severe weather early warning transmission procedure for the CoCT
	Flood-risk pamphlet	Investigate flood risk communication material
CoCT Disaster Risk Management Centre	Flood-risk assessment report	Investigate the assessment of flood-risk
	Flood-risk pamphlet	To investigate the communication of flood-risk to informal residents
	Flood incident records and reports	Document recorded flood disaster history of Masiphumelele and Kosovo
Phd Student	Minutes of interviews with CoCT Officials	Review minutes of interviews with City Officials to avoid multiple interviews processes
Newspapers	Newspaper articles	Gain further insights into recurrent flood events, response to flooding and experiences of flood-prone residents

Spatial data were sourced from Google Earth. These provided information on the location of Masiphumelele and Kosovo informal settlements within the CoCT. Furthermore, time-series maps of Kosovo and Masiphumelele were provided by the Disaster Mitigation for Sustainable Livelihoods Programme (DiMP) and Google Earth to illustrate escalating densification of settlements over time.

4.3 Tools for Primary Data Collection

4.3.1 Introduction

The tools developed for the primary collection of data were enabled through the extensive field experience of the researcher, allowing for innovative development and use of participatory methodology. The researcher's familiarity and knowledge of informal settlements was informed through experiences in facilitating Community Risk Assessments (CRA) during her honours year

(2006) in Masiphumelele, as well as in the TEAM (Training, Education, Awareness and Marketing) Project (2006-2007) and DiMP CRA short courses undertaken in numerous informal settlements (2009-2010).

The researcher's experience in informal settlements and her ability to speak and understand IsiXhosa, facilitated entry into Kosovo and Masiphumelele, and allowed for nuanced interpretation of data.

The researcher enlisted the assistance of a research assistant to ensure 60 household interviews were completed within a limited timeframe. The research assistant was familiar with the field and research context, with experience in conducting research through one-on-one interviews.

4.3.2 Household and CoCT Officials questionnaires

Semi-structured questionnaires were developed for flood-prone residents of Kosovo and Masiphumelele and Officials of the CoCT. This enabled the researcher to conduct her interviews in a less formal and flexible manner. It further allowed the researcher to explore issues in greater depth, providing useful qualitative data for the study.

The first household questionnaire developed was piloted in Masiphumelele informal settlement among ten randomly selected households. During this phase, several questions were found to have short-comings. For example, due to limited knowledge of early warnings among local community members, it was necessary for the researcher to rephrase and formally translate questions. This resulted in the questionnaire being refined, with a new version being applied to thirty households in Masiphumelele. However, prior to the subsequent interview process in Kosovo informal settlement, the questionnaire was further refined.

4.4 Selection of research assistants

Kosovo and Masiphumelele informal settlements are primarily isiXhosa-speaking settlements, which required the identification and employment of translators. One translator from each settlement was identified with assistance from DiMP. Each translator then sought a second translator in each settlement to ensure one translator accompanied both the researcher and the research assistant.

All translators were respected and known members of the community, and have lived in their communities for a substantial period of time. They had been employed by DiMP in the past, and therefore had experience assisting with household interviews. Two female translators were employed in Masiphumelele, and two male translators were employed in Kosovo. The researcher and research assistant accompanied and were present with the translators throughout the primary data collection phase.

Following an oral briefing of the research project, the translators provided an orientation to the settlement, identifying high risk areas and households most prone to rising floods, as well as capacities and resources found in the settlement.

4.5 Selection of study sites and community entry

Kosovo and Masiphumelele informal settlements are both regularly profiled as flood-affected in the local media. Both settlements have been identified by the DRMC as high flood-risk areas; with both settlements ranked within the ten highest flood-prone settlements by the CoCT in 2009 (CoCT Department of Roads and Stormwater, 2009).

In addition, extensive research has been undertaken in both informal settlements, allowing easier access to the community, and access to other complementary data sources.

Staff members at DiMP facilitated the community entry process by introducing the researcher to the translators for each community. The translators then provided an orientation of each study site, made arrangement for focus group discussions and introduced the researcher and assistant researcher to respondents of the household interviews.

4.6 Selection of study sample

The sample group for both Kosovo and Masiphumelele included those living in informal dwellings located in flood prone areas, within or adjacent to wetland areas. A total of sixty household interviews were conducted; thirty household interviews in each settlement.

The following factors were considered in the selection of individuals to be interviewed:

- The length of time individuals have resided in Cape Town, to determine knowledge of seasonal weather patterns and flood-risk in informal settlements
- Gender, to examine male and female interpretations, understanding and response to flood-risk and risk communication
- Age, to determine if age influences the use of various modes of communication, and the perception and management of local flood-risk

4.7 Primary Data Collection through Field Research

The field survey was conducted over a period of six days in the month of April 2010 near the onset of the Western Cape's winter rainfall season. Three days were spent in each settlement. One day was dedicated to a focus group discussion session, and two days dedicated to interviewing thirty households in each settlement.

The translators introduced the researcher and research assistant to members of the community. The translators guided the researcher and research assistant on a transect walk through the most flood-prone areas of each settlement, and assisted in the focus group discussion sessions, during the household interview process and in making field observations.

4.7.1 Qualitative data collection

Focus group discussions

The rationale underlying the focus group discussions was to gather baseline information and knowledge about the flood-risk and social context in Kosovo and Masiphumelele, before embarking on the household interview process. Information gathered from focus group sessions, through discussion, participation and debate of all participants, assisted the researcher in better understanding recurring flood-risk, individuals and groups most exposed to flooding, and who and which areas are most impacted by winter flood events. Participants in focus groups also provided information on how community members respond to flood-risk prior to, during and following a flood event, and discussed local 'unofficial' early warnings for severe weather events used by community members.

The focus group sessions in both settlements continued for approximately two hours and comprised largely female participants. Eleven participants attended in Masiphumelele, while approximately twenty five participants attended the focus group in Kosovo. The focus group in Masiphumelele was held in a make-shift informal church, and the focus group in Kosovo was held in an informal dwelling belonging to a local community member.

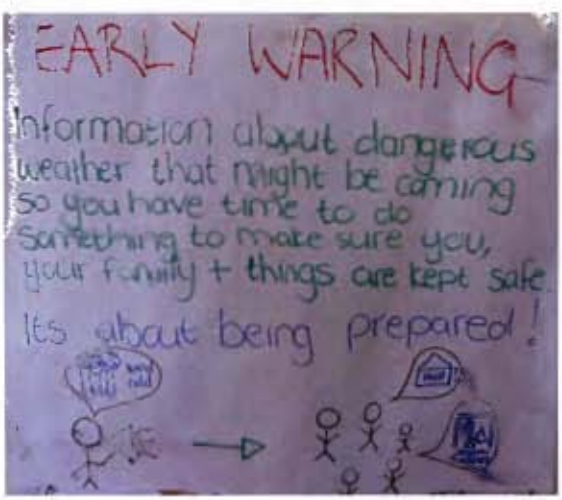
Three participatory methods were used to initiate discussions around key issues the facilitator wished to acquire information about. The objective of the first exercise in the focus group was to determine whether or not participants understood the concept of an early warning. Participants were provided with a number of cards and were encouraged to write down their understanding of early warnings, illustrated in picture 4. The cards were stuck onto flip chart paper and grouped into themes. Two themes were identified, namely preparedness actions, and means of acquiring warning messages.

Picture 4: Focus group exercise 1, determining participant's understanding of early warnings

The facilitator used the two themes to assist participants in understanding the difference between early warning messages and preparedness actions. Illustrative drawings on flip chart paper were used to facilitate understanding of EWS, shown in picture 5 and 6, overleaf. Finally, a definition of an EWS was provided to participants at the close of this exercise, shown in picture 7, overleaf.

Picture 5: Illustration used to show a flood event without a flood early warning system

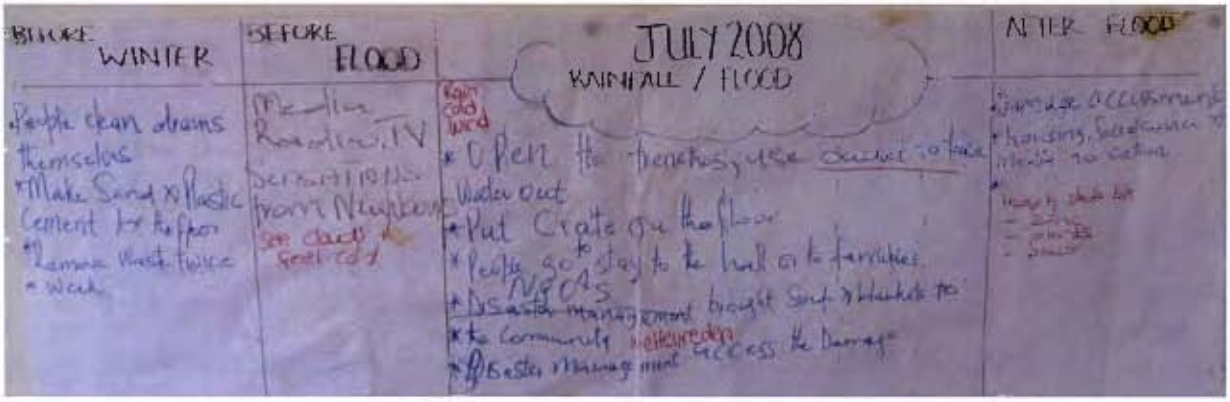
Picture 6: Illustration used to show a flood event with a flood early warning system



Picture 7: Definition of an early warning provided to focus group respondents

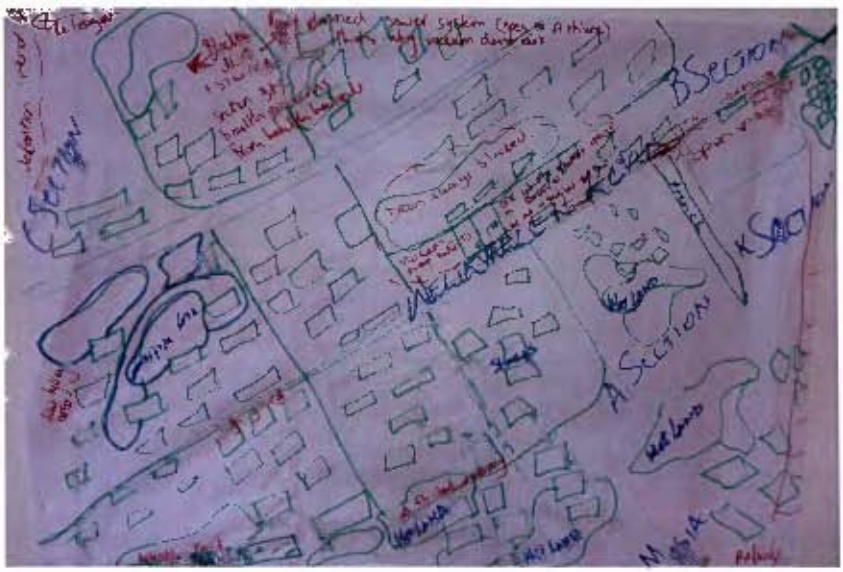
In the second exercise, participants were asked to write down and discuss the ways in which households respond to flood-risk before, during and after a severe weather event. A timeline was drawn up using flip chart paper, as shown in picture 8, and participants were asked to list activities and actions taken by community members and authorities before, and during and after a flood

event. The July 2008 flood event was used as an example of an extreme weather event in which many participants had to respond too.



Picture 8: Focus group exercise 2: Identifying responses to flood-risk before, during and after a severe weather event

The objective of the third and final exercise was to identify high flood-risk/impact areas in both settlements, using a mapping exercise (picture 9). Participants were provided flip chart paper and pens, and were encouraged to work together to identify major flood prone areas, and identify reasons for vulnerability to flooding. Key infrastructural elements were identified and marked on the map, including detention ponds, stormwater drainage, garbage containers/dumps, pump station and major access routes.



Picture 9: Focus group exercise 3: Flood-risk map

Interviews with CoCT Officials

City Officials interviewed for this study included CoCT Managers from the Roads and Stormwater Department and the CoCT Disaster Risk Management Centre. City Officials interviewed are listed below.

- Disaster Risk Manager from the DRMC head office
- Disaster Risk Operational Field Manager
- Strategic Roads and Stormwater Manager
- Operational Support Specialist of the Roads and Stormwater Department

In addition, a Weather Forecaster for the Cape Town Regional Office was interviewed.

General issues addressed by the questionnaires designed for City Officials included:

- Flood-risk management approaches, activities and perceptions with respect to flood-prone informal settlements
- Early warning systems for severe weather events: structure, risk information dissemination procedure and target audience
- Public participation

4.7.2 Data collection through semi-structured household interviews

Household interviews were conducted in the actual homes of respondents, where it was less intimidating and ensured confidentiality of responses. Each interview conducted was directed to the individual who resided in the dwelling in which the interview took place. Furthermore, individuals interviewed had to have experienced at least one flood event in the dwelling in which they lived. The interviews took approximately twenty minutes to complete.

Quantitative and qualitative data gathered by the household questionnaire for the households interviewed included:

- Profile of respondents
- Residential information (length of stay in informal settlement, structural characteristics)

- Technological modes of communication utilized by community members i.e. telephone, television or radio
- Flood-risk perception, and preparedness and management measures employed
- Knowledge of weather warnings and access to risk information and assistance
- Evacuation behaviour as well as perceptions and use of temporary flood shelters

See appendix 5 for a copy of the household questionnaire used for this study.

4.8 Data Consolidation and Analysis

4.8.1 Consolidation of qualitative data

Notes and comments collected from focus group discussions, and interviews with City Officials and households were transcribed and consolidated immediately after field research. Qualitative data were organised into themes according to the study's conceptual framework. This process allowed recurrent themes as well as data collected from secondary sources to more readily supplement quantitative findings, providing greater depth and meaning to the qualitative results.

The use of qualitative methods was also important for understanding people's perception of flood-risk as well as the informal settlement context in which they live. It allowed the researcher to capture more detailed information of community members and how they cope during the winter rainfall season.

4.8.2 Consolidation of quantitative data

The primary tool used to capture and analyse quantitative data collected from household interviews was Microsoft Excel Software. The data were captured using a table in a spreadsheet allocated to each settlement. The following descriptive techniques were used in excel:

- Generation of bar graphs to assist with visual presentation of data, visual comparison of data and determining the distribution and organization of data
- Generation of pie charts to assist with visual presentation of data, and determining size and proportions of data for a range of categories or topics
- Descriptive statistics, including mean, maximum and minimum values and percentages

4.9 Stages in the Research Process

This research took place through four main phases over the period from December 2009 to September 2010, as summarised in table 3, overleaf.

Table 5: Summary of data collection and analysis process for this study

No	Step	Purpose	Method
1	Preparatory work for field research December 2009 – April 2010	Select research sites	Consult DiMP staff and flood records history
		Collect secondary data for background information on settlements	Reading local government strategies and reports, newspaper articles and flood risk pamphlets
		Select and prepare data collection tools	Develop household questionnaire
			Prepare schedule for interviews with City Officials, household interviews and focus groups
		Select research assistants	Consult DiMP staff
		Pilot testing of household questionnaire	Ten randomly selected households interviewed
2	Primary data collection March - April 2010	Qualitative data collection	Two focus group discussions
			Five interviews with City Officials
		Sample selection for household questionnaire	Transect walk through most flood-prone areas of each settlement
		Quantitative and qualitative data collection	A total of sixty household interviews, thirty in each settlement
3	Consolidation of data June 2010	Consolidate qualitative data	Transcribing and summarising notes and organising data into themes
		Consolidate quantitative data	Microsoft Excel Software
4	Data analysis August 2010 – September 2010	Organise socio-demographic data	Descriptive statistics and application of qualitative data
		Organise and generate risk governance data	
		Organise and generate flood-risk behavioural patterns and perceptions	
		Generate data for comparing the two informal settlements	

4.10 Summary

The chapter described the data collection process and method of data analysis. It outlined the preparation of data collection tools as well as the methods used for data analysis. Qualitative and quantitative methods used to collect the data were discussed including the process of developing household questionnaires, and selecting the study sites, research assistants and sample groups. The data consolidation process was described, and a summary of the research phases was provided.

CHAPTER FIVE
FINDINGS

5.1 Introduction

The study's primary focus was to examine the feasibility of developing and implementing people-centred flood EWS in Kosovo and Masiphumelele informal settlements in the CoCT. Given the study's specific emphasis on flood EWS, and to align findings with prevailing literature, the chapter is ordered according to the categories outlined in the conceptual framework in section 2.8.

The chapter begins by first presenting the socio-demographic profile of study respondents in both Kosovo and Masiphumelele. Risk communication findings are then presented according to two categories of factors, identified by the literature as influencing the risk communication process. The first category includes 'factors influencing formal flood warning processes', namely risk assessment, design of flood warning mechanisms and flood warning messages. The second category refers to 'behavioural factors that influence flood warning response', namely flood-risk and warning perceptions and attitudes as well as behaviour in response to flood-risk and warnings. The chapter concludes with an analysis and summary of key findings, and an assessment of CoCT's risk governance approach.

5.2 Socio-Demographic Profile of Study Respondents

This section details the socio-demographic profile of residents interviewed in both Masiphumelele and Kosovo, and includes age, gender, language and level of education of respondents. Additional details provided include the duration respondents have lived in Masiphumelele and Kosovo, their reason for living there and the building materials used to construct their informal dwellings. The individuals interviewed at the household level were not the same as those participating in the focus group discussion sessions.

5.2.1 Demographics of Kosovo and Masiphumelele sample group

The age distribution of respondents interviewed according to gender in both settlements is illustrated in figures 11 and 12, overleaf. The majority of individuals interviewed in Kosovo ranged

between the ages of 26 and 45, and between the ages of 21 and 40 in Masiphumelele. In both settlements, significantly more female individuals were interviewed.

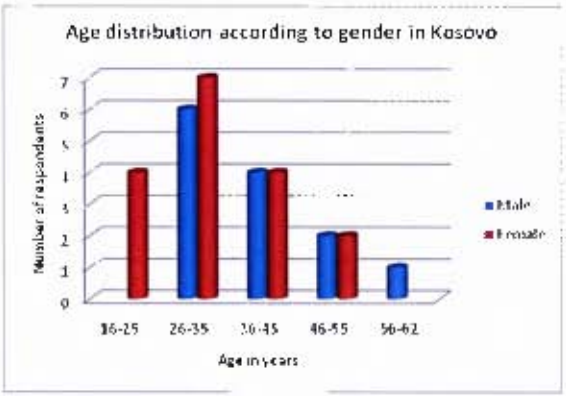


Figure 11: Age distribution of Kosovo respondents according to gender

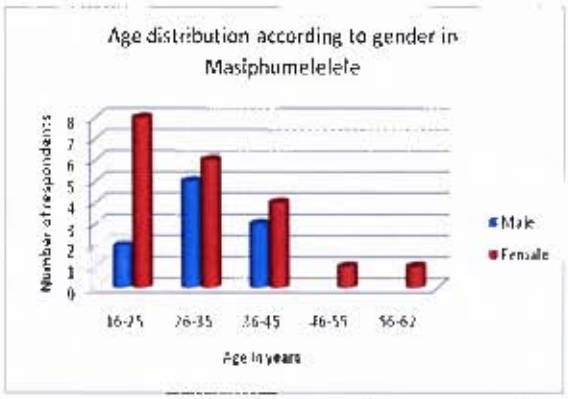


Figure 12: Age distribution of Masiphumelele respondents according to gender

Since the focus of the thesis is on risk communication, the facility around language was an important consideration. The first language of all respondents in Kosovo and Masiphumelele was IsiXhosa, with 57 out of 60 respondents reportedly able to read IsiXhosa. Figures 13 and 14 below illustrate the proportion of male and female respondents able to speak and read English. In Kosovo, a higher percentage of male respondents reported a stronger capacity in English, compared with Masiphumelele, where female respondents were found to have a stronger capacity in English. Of the total number of respondents in both settlements, only 44 and 36 out of 60 were able to speak and read English respectively.

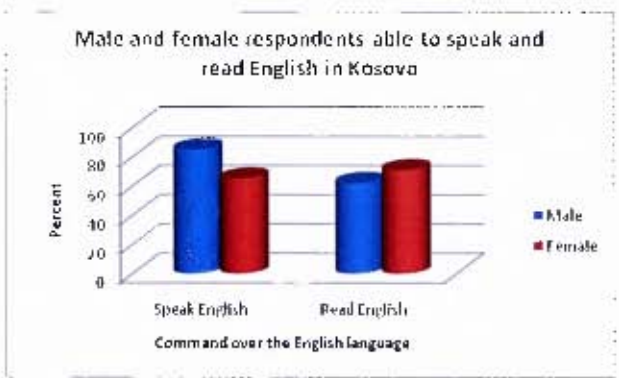


Figure 13: Distribution of Kosovo respondents able to speak and read English

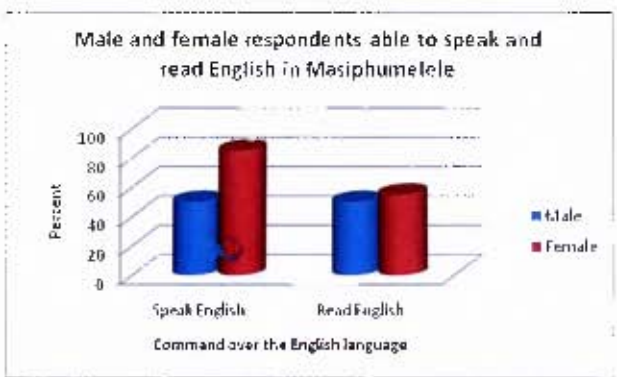


Figure 14: Distribution of Masiphumelele respondents able to speak and read English

Figures 15 and 16, overleaf, illustrate the percentage of respondents who reported completing grade 12 (matriculated) as well as those who had not completed their schooling (DNC). While results from both sample groups did not vary significantly, further analysis revealed that a higher number of

females had not completed high school in both sites. Only one respondent across both settlements revealed she had not received any education.

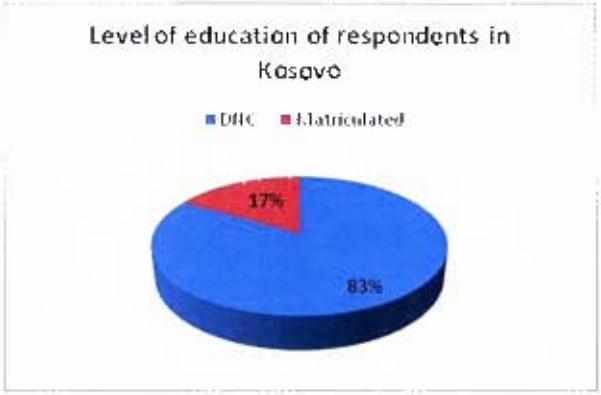


Figure 15: Percentage of Kosovo respondents who did and did not complete their schooling

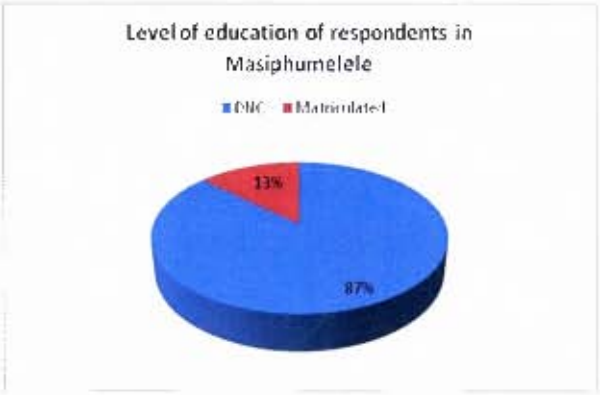


Figure 16: Percentage of Masiphumelele respondents who did and did not complete their schooling

5.2.2 Length of stay in informal settlement and characteristics of dwelling

Respondents provided the date of their arrival in the informal settlement in which they now live. The number of years respondents had lived in Kosovo and Masiphumelele are illustrated in figures 17 and 18. Respondents living in Masiphumelele had on average lived there for 9.2 years, slightly longer than those living in Kosovo, an average of 7.2 years.

Figure 17: The number of years respondents have lived in Kosovo

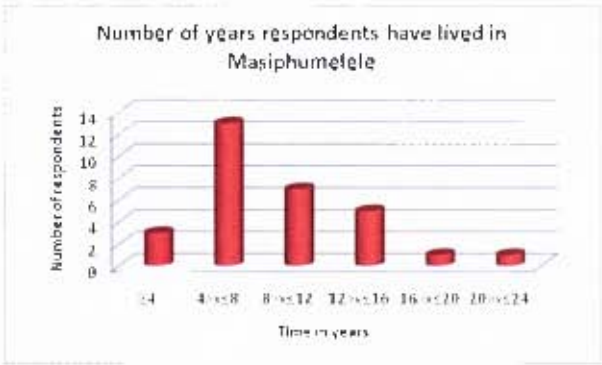


Figure 18: The number of years respondents have live in Masiphumelele

Reasons provided by respondents for choosing to live in Kosovo are illustrated in figure 19, overleaf. The most frequently noted included obtaining a space of their own (largely as their previous homes in other settlements had become 'too full'), relocating for employment opportunities, and relocating to be with family and friends already living in Kosovo. Unfortunately, during the initial stages of research conducted in Masiphumelele, this same question was not included in the survey. However, through informal discussions, it was established that the majority of those living in Masiphumelele

choose to live there for employment opportunities. This was attributed to Masiphumelele's location – close to industrial areas and surrounding suburbs. This provides opportunities for domestic service and casual labour.

These results indicate that respondents choose to live in Kosovo and Masiphumelele despite the consequences of frequent and recurrent flooding. This choice is made in favour of the benefits and convenience of living close to employment areas, shops and main transport systems and routes.

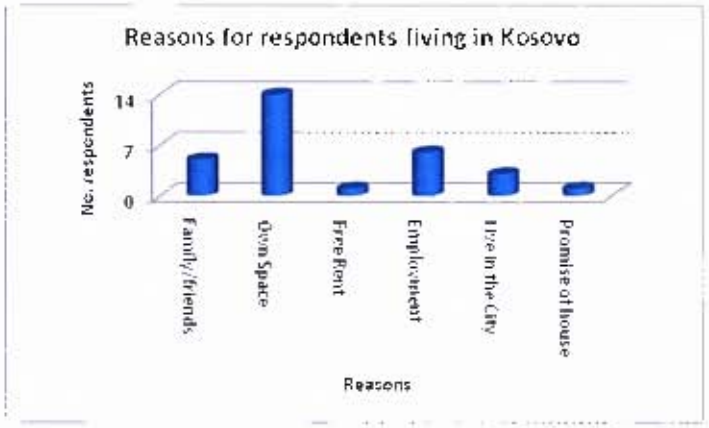


Figure 19: The reasons provided by respondents for choosing to live in Kosovo

During the household interviews, the researcher observed and identified the building materials used to construct the dwelling's roof, walls and floor. These constitute important flood exposure and vulnerability factors. Findings are presented in figures 20 and 21. In Masiphumelele, the material used for the floor was not observed. The most frequently used material for roofing in both Kosovo and Masiphumelele is Zinc. In contrast, walls were constructed using different materials. In Kosovo, dwelling walls were built using ceiling boards and zinc, while in Masiphumelele, wood was a more popular material. Flooring in Kosovo primarily comprised compact sand, often covered with carpeting, sail or plasstic material.

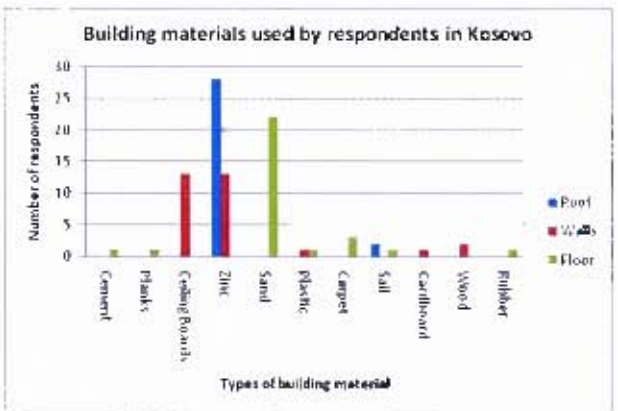


Figure 20: Building materials used by respondents in Kosovo

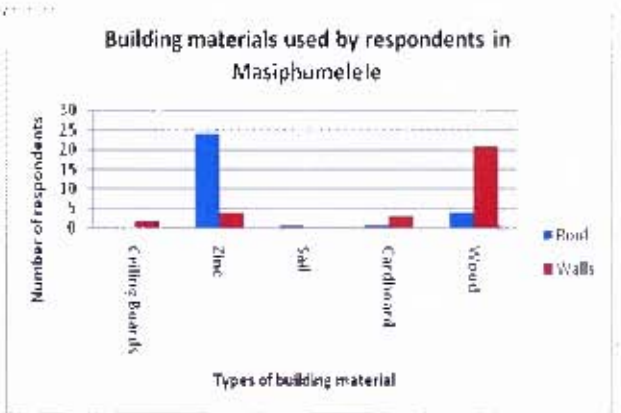


Figure 21: Building materials used by respondents in Masiphumelele

5.3 Risk Communication Process: Focus on informal settlement respondents

5.3.1 Overview

Risk communication findings concerned with informal settlement residents are clustered in two categories, using data from focus group sessions and household interviews. The first includes those factors influencing formal flood warning processes, namely risk assessment, design of flood warning mechanisms and flood warning messages. The second cluster includes those behavioural factors influencing response to flood-risk and warnings. These include perceptions of flood-risk and warnings, and the attitudes or behaviours in response to flood-risk and warnings.

5.3.2 Factors influencing formal flood warning processes

Overview

The literature identifies three major stages in the flood-risk communication process, namely assessment of flood-risk, design of flood warning mechanisms and communication of warning messages. These stages play an important role in influencing the formal flood warning process.

Flood-risk assessment

Community participants in focus group discussions in both sites revealed that government and external consultant-led flood-risk assessments had been undertaken in both settlements. However, the reported assessments did not cater for the priorities and needs of those exposed to risk of rising flood. Focus group participants reported that individuals from outside the community "take photos" and ask risk-related questions, however despite this, community members rarely receive feedback from these visits.

Design of flood warning mechanisms

Risk communication awareness: Respondents from settlements claimed to be unaware of any flood-risk communication measures developed by the CoCT for flood-prone informal settlements.

Moreover, none of the individuals in the focus group or those interviewed individually had ever been consulted in the development of flood-risk brochures or any other type of flood-risk communication.

When prompted, less than half the focus group participants in Masiphumelele revealed they had received a flood- risk brochure from the DRMC, only after a flood event had occurred. Respondents either denied ever receiving brochures, or indicated they found these "useless" or "unimportant" and therefore discarded them.

When asked to explain what an early warning system is for 'bad weather that might be coming', not one focus group participant in either settlement could explain or define early warnings for severe weather events. Instead, participants were only able to provide examples of official and unofficial early warnings used by flood-prone individuals, or the preparedness actions they take in anticipation of a flood event. Unofficial warnings included the onset of black clouds, a certain direction birds fly (indicator of impending severe weather conditions), and feelings or pains experienced (indicator of impending wet weather conditions). Preparedness actions included raising the ground level of a house, using silicon to fill holes in the roof and digging trenches to divert water away from the house. In contrast, 16 and 12 out of 30 of household interviews in Kosovo and Masiphumelele respectively understood and could define the term early warning.

Modes of communication: To inform the potential design of local flood EWS for informal settlements, a means for communicating early warnings for severe weather events was investigated, by noting respondents' access to various modes of communication. Results are illustrated in figures 22 and 23, overleaf. In Kosovo, a greater proportion of respondents reportedly owned a mobile telephone and television set, than a radio. However in Masi, compared with Kosovo, fewer respondents (less than 50%) have access to all three modes of communication.

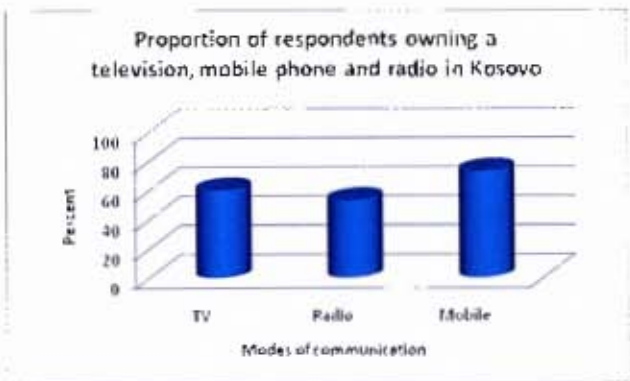


Figure 22: Modes of communication used by respondents in Kosovo

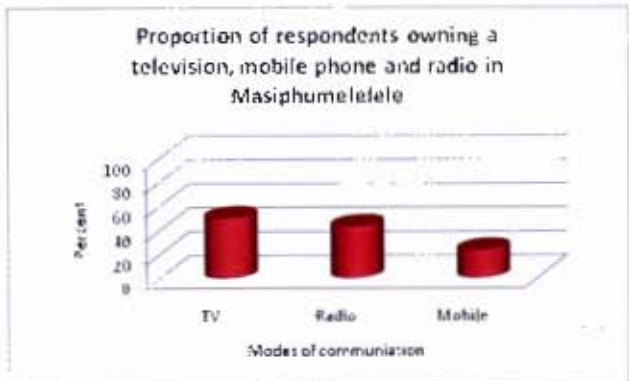


Figure 23: Modes of communication used by respondents in Masiphumelele

Flood warning messages

Respondents from both Masiphumelele and Kosovo detailed ways in which they hear about, sense or realise severe weather is approaching. Results are illustrated in figure 24, overleaf.

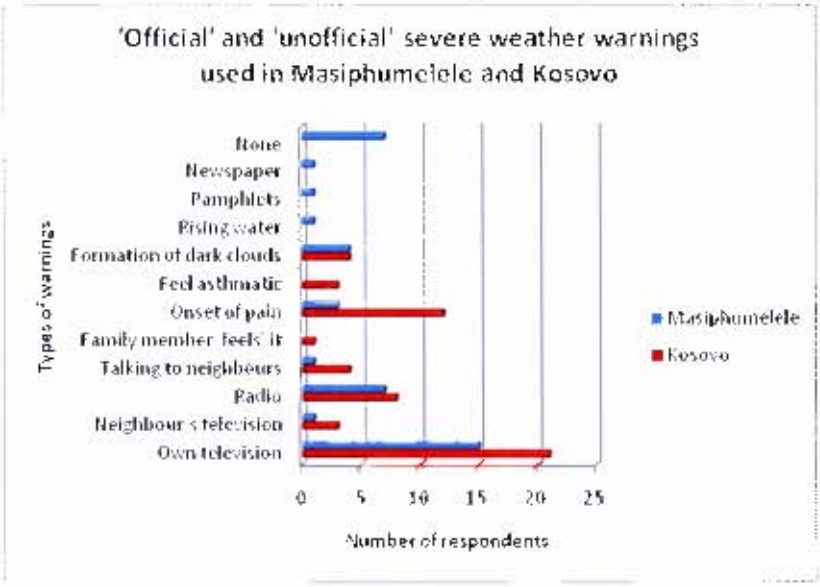


Figure 24: Formal and informal early warnings for severe weather events provided by respondents in both Kosovo and Masiphumelele

'Official' early warnings: At least half the respondents in both settlements followed the weather report on their television to determine probability of rainfall in their area. Respondents have also developed their own probability (or prediction) of rainfall based on the accuracy levels of percentages of rainfall provided by weather reports. For example, some individuals explained that a weather forecast stating 60% of rainfall was to be expected in a certain area indicated increasing probability of rainfall, while others felt more confident of the occurence of rainfall when 80% or more chance was reported by the weather forecaster.

'Unofficial' early warnings: A number of respondents in both sites reported developing means of self communication of flood-risk through personal observations of environmental cues, and personal 'feelings'. Examples of environmental cues included formation and colour of clouds, birds flying in a particular direction, and more immediate cues such as the onset of rain and gradual rise of water. One individual claimed he could smell a "difference in the air" when rain is approaching. Personal 'feelings' experienced by residents included 'strange itchy or painful feelings in surgical scars',

painful plantar warts, onset of asthma-related symptoms, arthritic pain, and pain experienced in teeth, kidneys, ribs and stomach.

5.3.3 Behavioural factors influencing flood warning response

Overview

Parker's flood- risk communication model recognises the role of behaviour and attitude, as well as flood-risk perceptions, in shaping responses to flood warnings. Risk communication findings of informal settlement respondents are presented in relation to these behavioural factors.

Flood-risk and flood warning perceptions

Significant severe weather conditions: 57 out of 60 respondents in both settlements revealed rainfall as a significant problem causing discomfort, floods and damage to property. More respondents in Masiphumelele than in Kosovo indicated windy conditions as a significant problem in the area, causing damage to informal dwellings, and triggering or worsening flood water inside dwellings. Findings are illustrated in figures 25 and 26.

Significant severe weather effects: In both sites, respondents reported that the most significant effect of excess rainfall was upwelling of water inside informal dwellings. Other severe weather effects included leaking roofs, and inflow of water through doorways, largely as the floor of many dwellings is lower than the ground level outside of the dwelling. Furthermore, particularly in Masiphumelele, 24 out of 30 of those interviewed reported that windy conditions were responsible for blowing roofs off dwellings and causing already unstable dwellings to shake dangerously. Other impacts identified are illustrated in figures 27, overleaf.

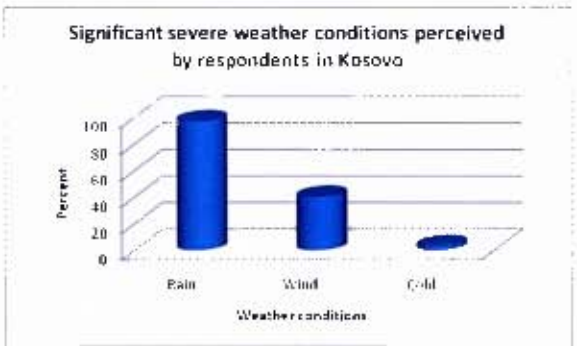


Figure 25: The most significant weather conditions impacting on respondents in Kosovo

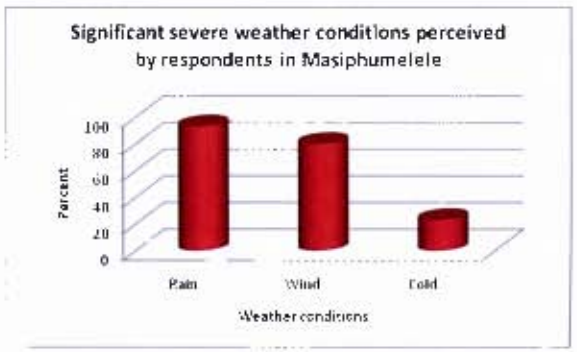


Figure 26: The most significant weather conditions impacting on respondents in Masiphumelele

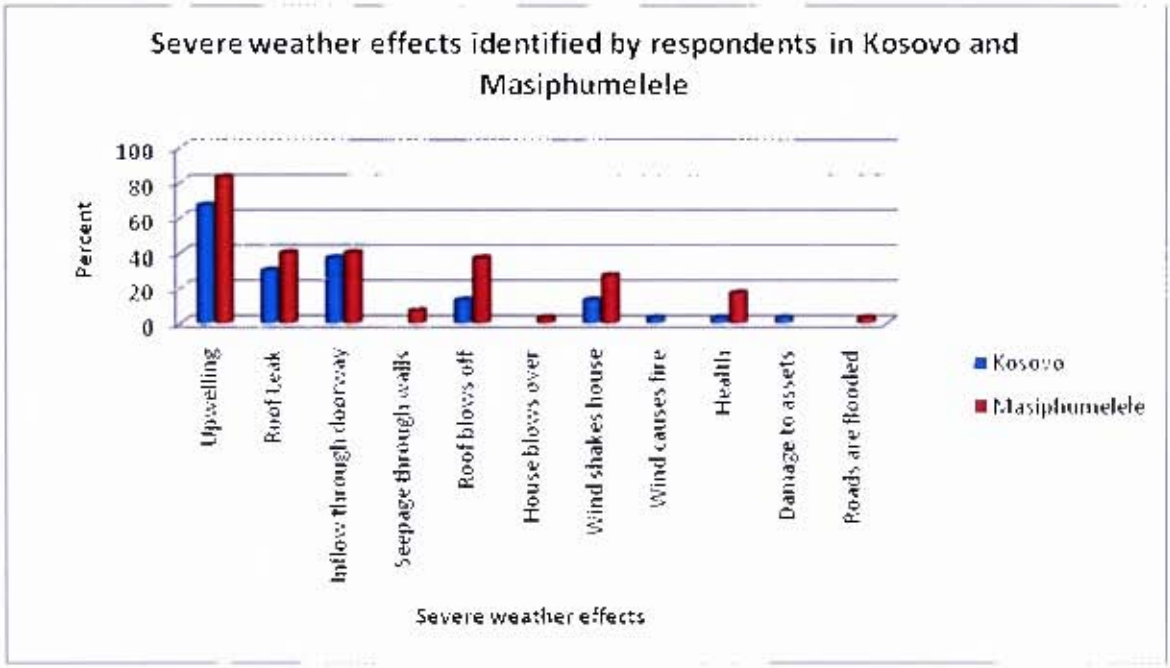


Figure 27: Severe weather effects identified by respondents in Kosovo and Masiphumelele

Local perceptions of flood-risk: Respondents in both settlements provided reasons for why they believe they are exposed to flood-risk. Findings are illustrated in figure 28, overleaf. A belief shared by 17 and 12 out of 30 respondents, in Masiphumelele and Kosovo respectively, is that their location in a wetland area, also frequently referred to by respondents as 'the dam', increases risk of flooding. Of those interviewed in Kosovo, 8 out of 30 believed that living in depressions contributed to increased risk of flooding, whereas 4 and 3 out of 30 respondents blamed the high water table and blocked drains respectively. Of those interviewed in Masiphumelele 6, 5 and 4 out of 30 respondents emphasised poor building materials, inadequate housing and wet weather conditions respectively, exposing them to the risk of flooding.

Most reasons provided by respondents, relate to environmental and structural factors within the immediate vicinity in which they live, which increase the threat of flooding.

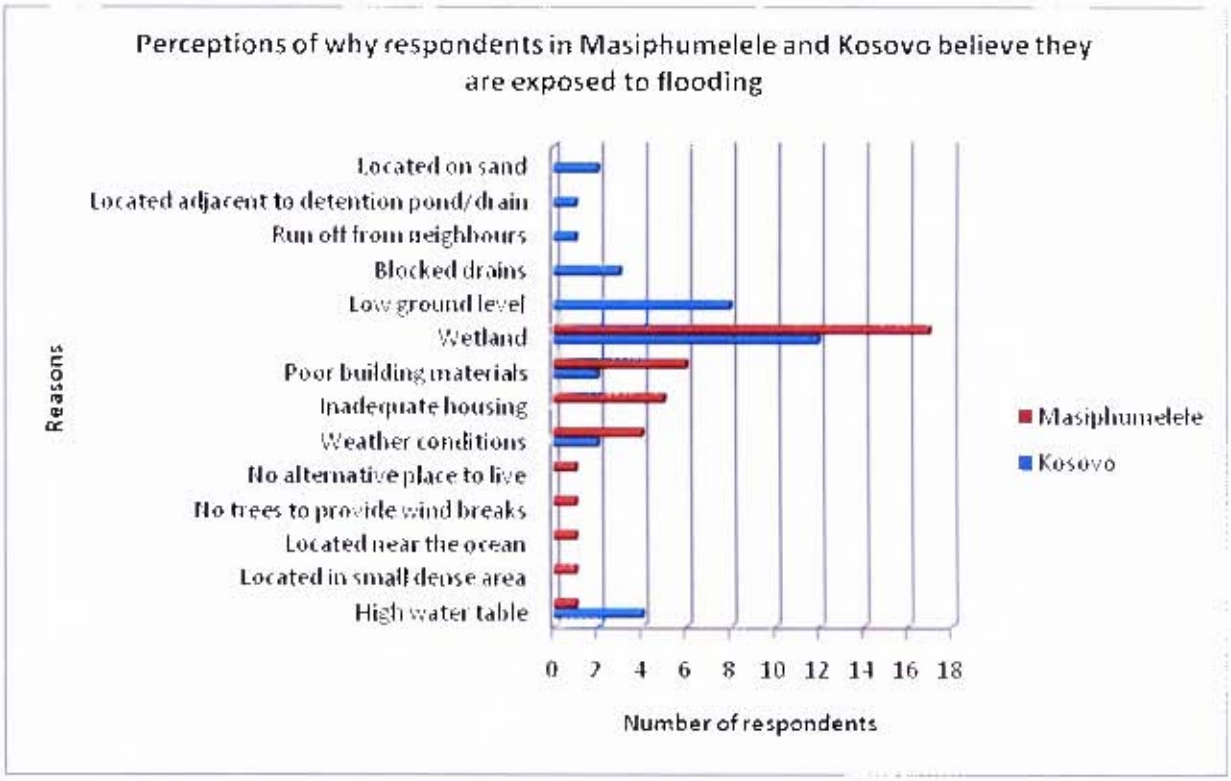


Figure 28: Perceptions of why respondents living in Kosovo and Masiphumelele are exposed to flooding

Need for EWS: Respondents in Kosovo were asked whether or not they felt there was a need for flood EWS. Results are illustrated in the pie chart in figure 29. Unfortunately, the same question was not included in the questionnaire for Masiphumelele respondents.

Of the individuals interviewed in Kosovo, 20 out of 30 respondents reported a need for a flood EWS. Four respondents recommended using a loud hailer to mobilise people before the area became flooded. One resident also suggested information and messages should be conveyed in IsiXhosa as many residents did not understand English very well.

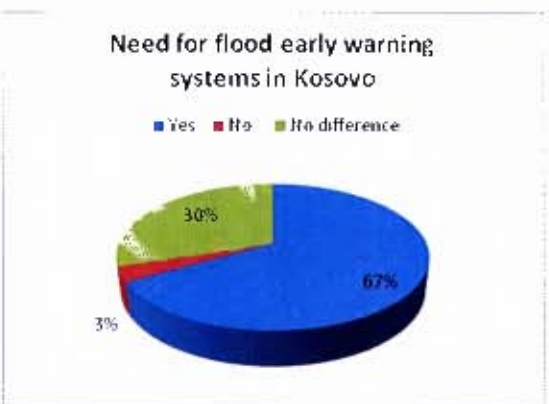


Figure 29: Flood-affected respondents' need for early warning systems, in Kosovo

Despite this, 9 out of 30 of respondents in Kosovo also perceived that flood early warnings would make no difference in reducing flood-risk and impact of flooding. They further argued that floods would occur regardless of the measures they took. Of the respondents, one was of the opinion that there is no need for flood EWS at all.

In addition, respondents from Kosovo proposed that local government provide more sand to level the area and raise levels of dwelling floors, find alternative flood-free locations and unblock drains more frequently, rather than "waste efforts" on EWS. They also emphasised that more effort should be made by local government in providing more resilient building material and providing people with the 'proper' houses they have been promised for so long.

Access to subsidised low-cost housing: The long term priority for flood-prone individuals in both Kosovo and Masiphumelele was the delivery of low-cost housing by the government. Of the individuals interviewed, 50 out of 60 respondents believed the provision of serviced low-cost housing would eradicate the problem of flooding in the CoCT.

Quotes from flood-prone individuals relating to housing...

'All we want are houses, we are not asking for money'.' How long are we going to fall victim of floods and fires?' Kosovo (Mbiza, 2008)

'We don't want your blankets. We don't want your food. What we want is proper houses...' Kosovo (Hweshe and Damane, 2008)

'When we voted this government into power we thought they would take care of our needs. Now they give us food and blankets but what we want is to be resettled and given houses' Kosovo (Hweshe, 2008)

Informal discussion with a mother living in Masiphumelele...

During a transect walk in Masiphumelele the research team happened across a young mother with a baby on her back. A discussion began around the reasons why people choose to live in Masiphumelele considering the poor conditions they have to live in. Without hesitation the mother explained '... people are living here because they are waiting to be given a proper house by the government. The same will be true for my baby. When my baby grows up he will build himself a shack here, and he himself will also wait to be given a house by the government...'.

Threat to assets and property: Respondents from both sites indicated that the threat of damage to and loss of assets as a result of flooding was great. This is evident in the adjustment measures employed by respondents in and around the dwelling to protect and preserve food and important possessions. Furthermore, when alternative means of shelter was provided to flood-victims in community halls, many reported staying behind to protect their assets for fear of theft and looting.

Indifference to ecological sustainability: Respondents harboured no interest in or demonstrated concern over the natural environment in which they live. They largely view the land as a viable and convenient option on which to locate.

Attitudes and behaviour in response to flood-risk and warnings

Flood-risk adjustments: Respondents from both settlements provided a number of ways they reduce the impact and severity of flooding. These are illustrated in figures 30 and 31. Table 4, overleaf, lists the adjustments in greater detail.

In Kosovo, just over half of respondents reported surrounding their dwellings with sandbags to reduce the impact of flooding, compared with 5 out of 30 respondents in Masiphumelele. However, in Masiphumelele, a frequently reported adjustment was securing the house against windy conditions. Other important flood-avoidance measures included raising the floor above ground level, using compact sand provided by CoCT trucks, blocking the doorway to reduce the inflow of water, and digging trenches around the house to divert water to the nearest water channels or drains.

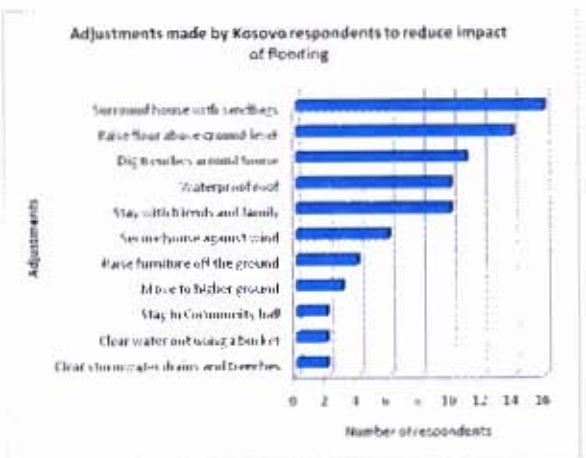


Figure 30: Adjustments made by Kosovo respondents to reduce impact of flooding

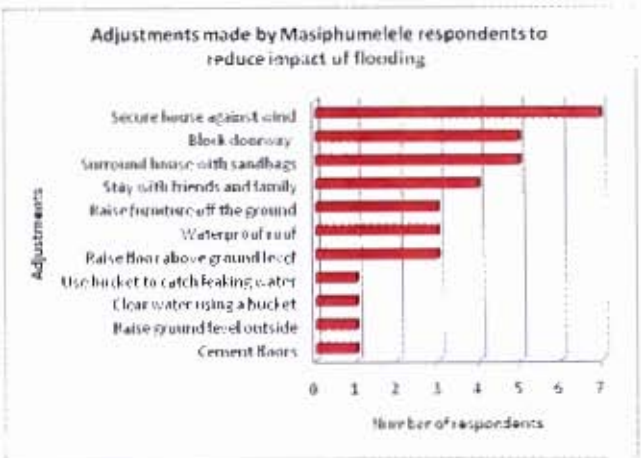


Figure 31: Adjustments made by Masiphumelele respondents to reduce impact of flooding

Table 6: Description of adjustments made to reduce the impact of flooding

Adjustments	Description
Raise furniture off the ground	Furniture placed on bricks, wooden blocks or boxes
Surround house with sandbags	Sand provided by the CoCT in trucks
Waterproof roof	Silicon used to cover holes in the roof
	Small balls of plastic used to block holes in the roof
	Plastic sheets line zinc roofs to reduce leaking
Secure house against wind	Newspaper used to block large holes in dwelling structure to prevent wind from blowing inside dwelling
	Stones or sandbags placed on roof to prevent it from blowing off
Dig trenches	Trenches dug around the house and water led to the nearest drain
Block doorway	Sandbags, bricks, planks or blankets used to block the doorway and prevent inflow of water
Raise ground outside dwelling	Cement used to construct a 'veranda' outside doorway to prevent inflow of water into dwelling

Despite the CoCT providing temporary evacuation shelters for flood-affected families, only two respondents in Kosovo, both women, reported staying in a community hall during severe floods. Other respondents in both sites reported refusing to stay in a temporary flood shelters due to lack of privacy and warmth, overcrowding, and shared space between men and women. Respondents reported either staying at home and coping with the flood event, or temporarily stay with family and friends.

Attitude towards flood-risk adjustments: Although most respondents reputed making some flood-risk adjustments, 22 out of 60 respondents noted these responses were futile. Common statements made by respondents include 'nothing can be done to stop the floods', and 'all I can do is throw out the water using a bucket'. In some cases, particularly in Masiphumelele, respondents admitted to doing nothing at all to prepare their houses for imminent floods as their 'dwelling will flood anyway'. One respondent was even quoted saying '... I just stay in bed until it stops raining'.

Opportunistic risk-taking behaviour: According to a number of focus group participants and interview respondents, residents desperate for housing viewed severe weather events opportunistically, resulting in risk-taking behaviour in an attempt to secure a low-cost formal home. Measures reported included using severe weather events as an opportunity to demand housing by

deliberately building dwellings in high flood-risk areas such as within the boundaries of the wetland area, low lying areas and in detention ponds.

Explanations for this were attributed to impacts of flooding in the CoCT in 2001. Respondents recalled a decision made by politicians to clear high flood-risk areas through prioritisation of flood-victims for housing. This led to housing projects being fast tracked to accommodate the needs of flood-victims. Although this solution is no longer utilised, perceptions of receiving a house if severely impacted persist ten years later.

Flood-risk responsibility: Respondents were of the opinion that it is the responsibility of the CoCT, and not theirs, to manage flood-risk and flood affects. They blamed the government for poor management of and response to urban flooding, and poor conditions in which informal settlement residents have to live.

Access to information: Table 7 lists the sources respondents use in times of crisis. A large number of respondents in both Kosovo and Masiphumelele maintain they know of nobody they can turn to for assistance before or during a severe weather event.

Table 7: Information sources using before, during and after severe weather events in Kosovo and Masiphumelele

Sources of Information used by respondents	Kosovo	Masiphumelele
None	11	19
Street Committee	10	
Councillor	7	
Family member	1	1
Neighbour/friend	1	3
Disaster Volunteer		4
Disaster Management		2
Community Leader		1

In both Masiphumelele and Kosovo, of those who sought assistance (30 out of 60 respondents), did so during or after a flood event, and not in preparation for a flood. Respondents sought assistance, during and after a flood, largely in the form of food and blankets and other flood relief items.

5.4 Risk communication process: Focus on local government officials

5.4.1 Overview

Findings concerned with local government officials are clustered in two categories. The first cluster includes those factors influencing formal flood warning processes, namely risk assessment, design of flood warning mechanisms and flood warning messages. The second includes behavioural factors influencing response to flood-risk and warnings. These are perceptions of flood-risk and warnings, and the attitudes or behaviours in response to flood-risk and flood warnings.

5.4.2 Factors influencing formal flood warning processes

Overview

This section presents the findings relating to factors influencing formal flood warning processes – risk assessment, design of warning mechanism and warning message, from the perspective of the City Officials interviewed for this study.

Risk assessment

Basic flood-risk assessments of informal settlements have been completed within the CoCT, by the Department of Roads and Stormwater, flagging informal settlements located primarily on the Cape Flats with a higher than average flood-risk profile (Bouchard, 2007). Risk assessments were conducted using existing spatial information and desktop topographical analysis using key locality factors associated with surface water accumulation as parameters (Ibid).

A risk assessment study for the Provincial Disaster Management Centre for the Western Cape was also undertaken. The assessment prioritised vulnerable communities in the Western Cape, focussing particularly on communities vulnerable to flooding and fire (AFRICON, 2009). Informal settlements most vulnerable to fire and flooding were ranked considering both hazards and vulnerabilities related to each settlement (Ibid). The most important consideration in prioritising flood-risk in informal settlements was 'exposure', considering the size and density of a settlement (Ibid).

These risk assessments determined level of flood-risk from a hazard perspective, assessing only technological and environmental factors, including severity of rainfall, and location adjacent to watercourses, within or adjacent to stormwater ponds and encroachment into wetlands. Socio-economic vulnerability factors are rarely included, largely due to difficulties in sourcing comprehensive and reliable information on informal settlements.

According to the CoCT Department of Roads and Stormwater (2009), Kosovo and Masiphumelele were ranked 1 and 4 respectively as high flood-risk areas, in 2009. Settlements were considered high flood-risk areas as approximately 1105 dwellings in Kosovo were located in undrained trapped low areas, and 304 dwellings in Masiphumelele were located in environmentally sensitive wetlands.

Design of flood warning mechanisms

Communication and awareness: The CoCT have developed a communication and awareness programme aimed at educating flood-prone communities on the impacts of flooding and the measures they should take to lessen flood impacts and knock-on effects. Awareness measures include media briefings, dissemination of press releases and public advisories. Additional efforts include building capacity among flood-prone individuals through dissemination of brochures, and facilitating workshops with community members. Communication measures are developed and disseminated with little or no consultation with flood-prone individuals and households.

Quote from Household Respondent

'We never see disaster management before the rains come, they only show up after it floods to give blankets and food'.

Quote from CoCT Official

'A portfolio of evidence is documented by CoCT Disaster Management of awareness programmes initiated and implemented by disaster managers, NGOs and other role players in flood-prone areas'.

A primary example, often discarded by flood-prone communities, is the flood preparedness trilingual brochure, 'Protect Yourself from Floods', developed and distributed annually before the winter rainfall season. Brochures illustrate flood prevention and mitigation measures for flood-prone communities. According to Officials from the CoCT, brochures were considered ineffective, particularly as they were not developed in consultation with communities. Brochures are allegedly

developed and disseminated by the CoCT due to pressure to implement and produce a tangible flood-risk management initiative, in a short period of time, with limited capacity.

Participation: No protocols, procedures or mandates are in place for how local government departments should engage and collaborate with at-risk communities. In addition, participatory and consultative methods are inconsistently applied and often neglected due to lack of resources, capabilities and capacities. Consequently, flood-prone communities believe they are not heard.

Participatory measures are either employed with caution, or neglected all together to avoid raising expectations among flood-prone communities. In so doing, CoCT Officials also avoid being more accountable to individuals and communities. The needs and priorities of informal settlement residents are seen as ambitious and near impossible to achieve by the CoCT, and are therefore rarely included or integrated into risk management plans and activities. This has on occasion resulted in angry confrontations between local residents and CoCT managers in the past due to the expectations of flood-prone communities not being met.

Quote from CoCT Official

'Community involvement is kept to a minimum as it is very difficult to provide for the needs of communities. Officials do not want to be held accountable to communities more than they already are'.

Quote from Household Respondent

'Government never listen to what we need, they just come and do assessments and leave without making changes that benefit us'.

Officials of the CoCT's DRMC explained that existing platforms, such as the Disaster Risk Management Advisory Forum and Flood Coordination Committee, did not include representatives of informal settlement residents. This was done to ensure the reduction of political and social complexities and acceleration of flood-risk management measures. Representatives were excluded partly because ward councillors - representing the needs and rights of those living under their jurisdiction, tended to politicise the plight of those exposed to risk, rather than cooperate and collaborate with CoCT officials in informal areas.

Flood warning messages

According to the CoCT DRMC every possible effort is made to warn all high-risk flood prone settlements of their exposure to the risk of flooding. Residents are encouraged to either relocate to a higher and safer location or take the necessary safety measures to protect their lives and property from the impact of flooding. However, due to lack of manpower and resources, CoCT managers struggle to communicate flood-risk information to ALL those living in flood-prone areas.

Useful pointers or 'tips' are provided by the DRMC to informal settlement residents, via the flood preparedness brochure and press releases in daily newspapers. These tips, provided in English, Afrikaans and IsiXhosa, assist in reducing the risk or impact of flooding, and include the following:

- Check that the drainage system on your property is not blocked
- Raise the floor level of your house so that it is higher than the land outside
- Move to higher ground if you stay in a flood-prone area
- Dig furrows to divert water away from the home
- Report any blocked drains, intakes and illegal dumping
- Waterproof roofs
- Clear gutters, downpipes and furrows
- Remove dead branches from trees
- Secure furniture against the wind

5.4.3 Behavioural factors influencing flood warning response

Flood-risk and flood warning perceptions

Flooding is avoidable: CoCT Officials interviewed from the Roads and Stormwater Department were of the opinion that the locations of Kosovo and Masiphumelele informal settlements are unsuitable for human settlement. This is due to their location adjacent to and partially within a wetland system. Furthermore, they believe it should not flood as much as it does considering the amount of rain that falls during the winter months. Flooding is therefore largely attributed to conditions of poverty, and poor urban planning and construction standards.

Simplicity of technical solutions: Attending to technical problems in flood-affected settlements is considered a simpler solution than taking on board solutions perceived as socially and politically sensitive in nature. Technical solutions include provision of storm water drains, clearing silt and debris from underground systems, stormwater catchpits, retention ponds and water channels, and ensuring effective and frequent waste collection prior to the winter rainfall season. City Officials have found great difficulty in empowering flood-prone residents due to local power struggles and political issues, often resulting in people sabotaging each other's projects.

Futility of EWS: CoCT Officials interviewed, particularly from the CoCT DRMC, were of the opinion that weather warnings are likely to go unnoticed by flood-prone residents, due to more pressing daily priorities and struggles of informal settlement residents. They also noted that residents did not value assistance in adapting to and coping with flooding. They emphasised residents' preferences for securing a long promised solution of a house.

Housing solution: CoCT Officials also believe flooding can only be solved through the provision of low-cost serviced houses. Current flood-risk management measures in informal settlements are largely viewed as short-term, reactionary and ineffective, as they do little to address the main issue, which is the demand for formal housing.

Flood-risk management and continuous maintenance of informal settlements is perceived as resource-draining and undermining the integrity of the natural environment. City Officials interviewed are of the opinion that the two settlements would not have an endangering flood profile had it not been for the unplanned settlement of wetlands.

CoCT Officials noted that more efforts are required for long-term efficient and equitable risk management policies, particularly at higher levels of government. In so doing, adequate resources will be made available for risk prevention, preparedness and most importantly, for solving the problem of the housing crisis. This is perceived as far more sustainable than continually mopping up after flood events in informal settlements. However, unfortunately, upper management and political role-players are often more interested in quick wins and fixes, and thereby focused on short-term solutions.

Ecological sustainability: CoCT Officials from the Roads and Stormwater Department recognise the importance of areas such as wetlands in terms their flood buffering potential and wish to preserve

them. Urban encroachment into these areas results in the degradation of the ecological environment thereby reducing the quality of water and ensuring loss of other ecological resources (De Wit *et al*, ND). The CoCT therefore strives to ensure inappropriate building is regulated in high flood-risk areas to safeguard community livelihoods, economies and health, while protecting, improving and maintaining the natural environment; ultimately ensuring that development and building is appropriate to the anticipated degree of flood-risk (CoCT Roads and Stormwater Department, 2009).

Attitudes and response to flood warnings

Self-reliance of communities: According to the CoCT DRMC, the focus of flood-risk management activities is to foster self reliance, where the provision of relief is considered an activity of last resort. The CoCT has limited resources for responding to households and individuals exposed to flood-risk, and therefore encourage residents to help themselves as best they can.

Pervasive emphasis on response: CoCT Officials believe management of flood-risk remains focused on response, rather than preparedness and prevention. This is in part due to resource constraints. Shortages of capacity and resources are also observed in the actual response to floods, particularly as multiple areas are affected at the same time when it rains. It is impossible to respond to all affected areas due to shortages in staff members, and it is difficult to prioritise areas as each area claims their situation to be worse than the next.

According to the City Officials interviewed, this is further exacerbated by the 'short memories' of politicians with regards to disasters, often making funding and resources available for tangible short-term 'quick-fixes' only. It was suggested that this is done to maintain the perception that local government is visibly assisting people within at-risk communities. As a result, many departments are frequently underfunded in their endeavours towards long term risk reduction and prevention.

5.5 Analysis and Consolidation of Risk Communication Findings

The research findings are summarised in table 8 on page 87. The findings have been structured according to factors influencing flood warning processes, and behavioural factors influencing response to flood-risk and warnings, from the perspectives of both flood-risk communication

stakeholder groups. Stakeholder groups include Officials of the CoCT and informal settlement respondents.

Analysis of findings was conducted for each risk communication stakeholder group, emphasising risk communication processes established for each group, and the bearing of such interactions on flood warning processes and responses to them. Through interpretation of the findings from both risk communication stakeholder groups from both study areas, the risk governance model employed by the CoCT was revealed and analysed.

5.5.1 Officials interviewed from the City of Cape Town

Official flood-risk assessments have been conducted in the CoCT, considering primarily environmental and structural factors that determine flood-prone community's exposure to flood hazards. Socio-economic variables however were largely omitted due to limited data and the social and political complexities they create.

Consequently, simple flood-risk solutions designed for and implemented in informal settlements are technically oriented, and rely little on the inputs of those living in flood-prone communities. Furthermore, due to resource constraints, flood-prone communities are encouraged to help themselves where they can.

Table 8: Summary of key research findings of the study

Communication stakeholders	Factors influencing formal flood warning processes			Behavioural factors influencing flood response	
	Risk assessment	**Risk communication design**	**Flood warning message**	**Flood-risk perceptions**	**Attitude/behavioural response**
Local government officials	Structural and environmental factors assessed to determine flood-risk	Education and awareness programme for flood-prone communities developed	Every effort made to warn high risk flood-prone dwellers of exposure to floods	Flooding is avoidable as informal settlements are located in unsuitable areas	The focus of flood management measures is to foster self-reliance among flood-prone communities
	'Exposure' commonly considered in terms of size, density and location of settlement	Risk communication measures used include media briefings, press releases, public advisories and brochures	Flood-prone individuals encouraged to relocate to high and safer ground and take necessary steps to protect themselves and property	Flooding is attributed to conditions of poverty and poor urban planning and construction standards	Flood management activities pervasively emphasise short term response measures to floods, largely due to resource constraints
	Socio-economic data is limited, inconsistently used and or discarded	Flood-prone communities not consulted in development of risk communication measures	Pointers provided via brochure and press releases on how to reduce the risk and impact of flooding	Technical solutions to flooding are perceived as simpler than local solutions are considered socially and politically sensitive nature	
		Public participation limited due to lack of resources, and to avoid raising expectations and accountability		EWS in informal settlements are futile as they would go unnoticed due to more pressing daily priorities and struggles of residents	
		Public participation considered socially and politically complex, slowing down implementation of flood management measures		Flooding can only be solved through the provision of serviced low-cost housing	
				Importance of maintaining the natural environment and ensuring ecological sustainability is recognised	

Informal settlement respondents	Factors influencing formal flood warning processes			Behavioural factors influencing flood response	
	Risk assessment	**Risk communication design**	**Flood warning message**	**Flood-risk perceptions**	**Attitude/behavioural response**
	Outcome of assessments do not cater for the priorities and needs of residents	Unaware of flood-risk communication measures developed by the CoCT	At least half the respondents claim to follow weather reports on television	Rain perceived as significant, causing discomfort, floods and damage	Implement short-term adjustments to cope with affects of flooding
	Flood victims receive food and blankets year after year.	Not consulted in the design of flood-risk communication material	Probability of rainfall defined by the individual based on past experiences	Common effect of severe weather conditions is upwelling of water	Choose to stay at home to protect assets and avoid poor conditions in temporary flood shelters
	Demands of living in safer areas, in serviced formal housing are constantly not met.		Self-communication of flood risk through observations of environmental cues, and personal 'feelings'	Common reason residents perceive they are exposed to flood-risk is location in a wetland	Flood-risk adjustments considered futile as it floods anyway
			Deny receiving brochures or discard them	Do not perceive flooding as a life-threatening hazard	Opportunistic risk taking behaviour to secure low-cost housing
				30% believe flood early warnings will make no difference as floods will occur regardless	Believe it is the CoCT's responsibility to manage flood-risk
				Believe local government should provide resilient building material or build 'proper' formal houses	Flood assistance largely sought during or after a flood event (More responsive than preventative)
				Believe the provision of low-cost housing will eradicate the problem of flooding	
				Threat of damage and loss of assets is perceived a greater threat than the loss of human lives	
				Indifferent to ecological sustainability	

Flood-risk communication and awareness programmes have been developed without consulting flood-prone communities. Risk communication is disseminated through the media and flood protection brochures, from local government role players to flood-prone residents. This is reflective of a top-down uni-directional risk communication process.

Moreover, City Officials interviewed were of the opinion that flood EWS will be ineffective, due to the pressing daily struggles of those living in informal settlements. They also argued that flood-prone residents prefer not to adopt measures to better cope with flooding, but instead have long-term desires for a formal house. CoCT Officials believe the stabilisation of land and provision of adequate housing will solve the problem of flooding, and ensure the conservation of environmental resources.

5.5.2 Informal settlement respondents

Flood-prone respondents are frustrated by the extractive nature of risk assessments conducted in informal settlements. They feel their needs and priorities are persistently overlooked by local government officials.

Since their needs and priorities are overlooked, informal settlement respondents feel indifferent toward flood-risk management measures implemented by local government departments. Consequently, flood-risk management measures are poorly maintained and tend to fall into disrepair.

All respondents reported flooding to be threatening to assets based on past observations and experiences, however not one reported the threat to human lives. Adjustments made by respondents were developed for the protection of the dwelling and all its assets. In addition, respondents reported staying at home during a flood event to ensure the protection of their assets.

Due to the lack of formal flood-risk communication in informal settlements prone to frequently occurring floods, respondents have developed their own means of self-communication. These include personal observations of environmental cues and personal 'feelings'.

Since respondents do not perceive flooding as life-threatening, and because they believe flooding will occur regardless of the actions they take, respondents indicated indifference toward flood EWS. Respondents expressed a preference for local government authorities to invest in provision of

formal houses. In addition, respondents indicated their intent to continue living in ecologically sensitive areas prone to flooding, due to the convenience of living near employment opportunities, shops, and major transport routes. This research also highlights the opportunistic behaviour of respondents, linked to the perceived benefit of securing a formal home.

5.5.3 Interpretation of Risk Governance in the City of Cape Town

As stated before, risk governance is an implicit element underpinning people-centred approaches to EWS, and in particular, transparent risk governance is a pre-condition necessary for effective development and implementation of PCEWS. Three models of risk governance, namely technocratic, decisionistic and transparent models, define the extent to which vertical and horizontal elements of risk governance engage and intersect. Based on the findings above, the risk governance model for the CoCT was assessed to better understand the communication and management of risk in the CoCT. This is expanded upon below.

Although it was established that a basic uni-directional flow of risk communication takes place in the CoCT, risk governance cannot not be strictly defined as technocratic. Some engagement between stakeholders does take place during the assessment, evaluation and management of flood-risk, even if not considered as ideal.

The risk governance model in the CoCT cannot be considered as transparent, particularly as flood-prone household respondents indicated they felt that their needs are not prioritised, and are constantly overlooked. CoCT Officials interviewed acknowledged their limited engagement with flood-prone communities due to limited resource and capacities, and the complex political and social nature of these communities. As a result, simple hazard focused solutions have been designed to meet the immediate needs of flood-prone areas.

Therefore, based on the above findings, one may conclude that a decisionistic model of risk governance is employed by the CoCT, as it exhibits more inclusiveness than a technocratic model, and less than that of a transparent model. Scientific (hazard focused) considerations are made during risk assessments in flood-prone areas, which inform the design and implementation of flood-risk solutions. However, CoCT Officials do engage with communities to the extent possible considering resource, capacity and time constraints.

5.6 Summary

This chapter has addressed the flood-risk communication context in Kosovo and Masiphumelele informal settlements through the consolidation of information derived from both primary and secondary sources.

The socio-demographic characteristics of respondents from each settlement were profiled. The factors influencing flood warning processes and responses to flood-risk and warnings were outlined and explored, for both informal settlement respondents and local government officials. Findings indicate a top-down decisionistic approach to flood-risk management, using a uni-directional approach of communicating risk.

CHAPTER SIX
DISCUSSION

6.1 Introduction

This final chapter discusses the risk communication findings in relation to prevailing literature on flood-risk, flood early warning processes and human behaviour in response to them, drawing on key issues highlighted in the study's conceptual framework.

The chapter begins by discussing urban flood-risk management in the CoCT, giving emphasis to the prevailing risk governance model and its implications for flood-risk communication. The realised experience of rising floods in informal settlements is also discussed. A description of the rising floods in informal settlements is provided; including the adjustments made by informal settlement respondents to prepare for and respond to flood-risk, and the attitudes and behaviour of risk communication stakeholders towards flood-risk.

The chapter concludes by highlighting the challenges and requirements, identified by the research findings, of implementing people-centred EWS for rising floods in informal settlements.

6.2 Informal Settlement Flood-Risk Management in the City of Cape Town

6.2.1 Risk governance

Transparent risk governance is an implicit precondition underpinning people-centred approaches to early warnings, ensuring the application of participatory approaches and interrogation of risk knowledge. An inclusive risk governance of this type is reflected in the multi-directional flow of risk information, illustrated in the risk communication conceptual framework in figure 32, overleaf. However, evidence from this study (summarised in table 8 on page 86) suggests a constrained governance approach to managing flood-risk in the CoCT, which provides little room for accommodating and facilitating all the elements of a PCEW approach. In particular, this approach is shown to discourage collective decision-making between governmental and non-governmental stakeholders. In this context, resource and capacity constraints, along with political impetus, within the CoCT contribute toward the use of this approach.

The primarily 'top-down' approach to managing flood-risk in informal settlements, described by City Officials interviewed, is consistent with Renn's (2008) decisionistic risk governance model, reflected by the uni-directional communication of risk information. This decisionistic model of risk governance adopted by the CoCT entails minimal community involvement at the risk assessment stage, instead placing emphasis on the assessment of scientific factors. It also involves incorporation of technical, economic and social factors in the evaluation and management of flood-risk. According to Graham (2006), this risk governance approach is usually favoured by officials as it allows them to determine the form of settlement intervention without requiring any further community input. He argues that this approach is preferred as long as it fulfils the political mandate of implementing cost effective tangible short-term solutions.

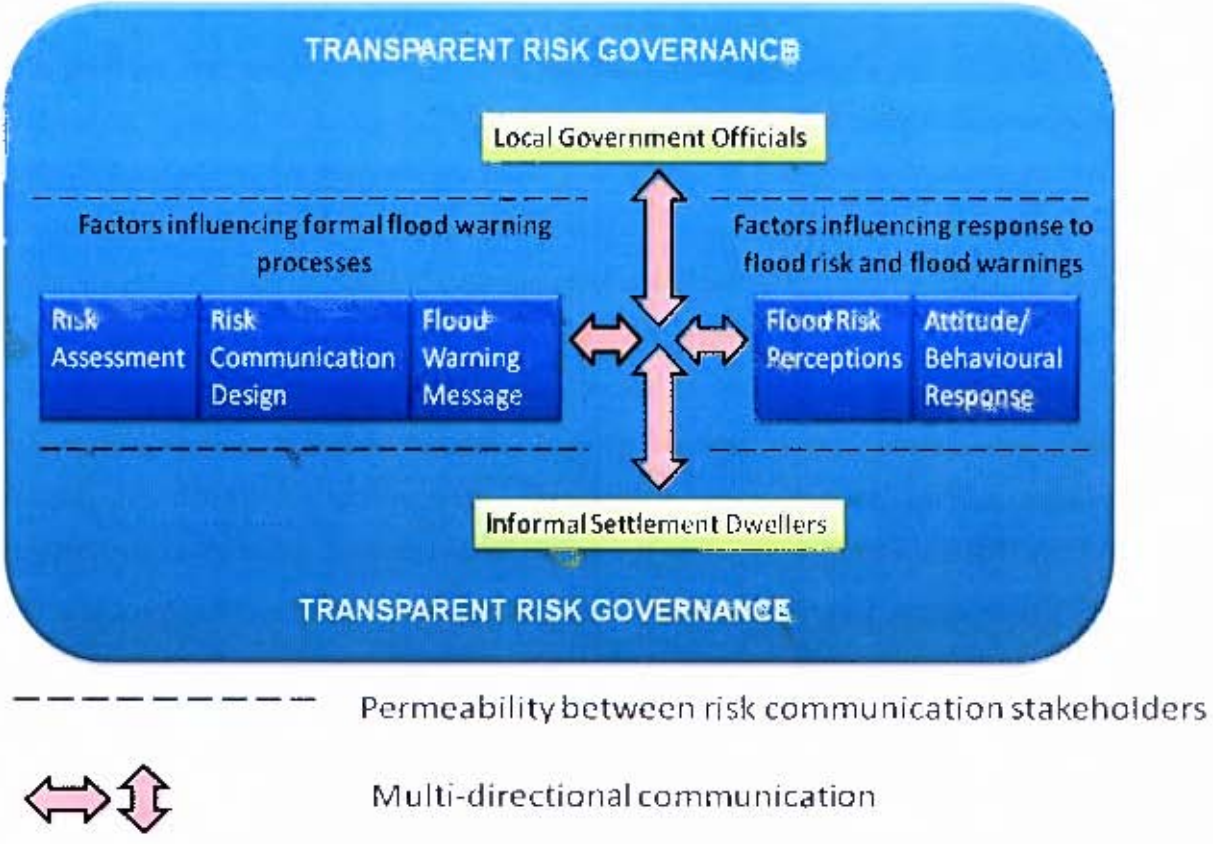


Figure 32: Conceptual Framework for the Study

The over-arching risk governance approach applied in the CoCT also influences the conceptualisation of flood warning processes. These include processes such as risk assessment, design of risk communication and the warning messages (the elements shown in the left-hand quadrant of the conceptual framework used in this study). In the context of this study, the governance model applied equates 'flood-risk' with conventional flood 'hazard' exposure. This prioritises factors such as

location, environmental processes and sensitivities, and prevailing weather conditions. As these assessment processes involve minimal engagement with flood-affected communities, they generate 'broad-brush' flood-risk management responses through primarily engineering and technical solutions. Moreover, risk assessment processes are not nuanced at the local scale where the probability of flood loss might be specifically realised as 'damage to removable property or assets' (as indicated in this study).

6.2.2 Risk communication

The use of a more decisionistic governance model by the CoCT also has implications for risk communication processes between local government officials and informal settlement residents.

Findings from this research indicate that flood-risk information is largely communicated uni-directionally, from the media and local government, to flood-prone informal settlement residents. In addition, findings indicate that information is *disseminated* to flood-prone individuals, with limited or no direct engagement with representatives of these flood-prone settlements. The risk communication findings of this study are therefore consistent with a uni-directional dissemination model, which is the outcome of a decisionistic approach to risk governance.

The research findings therefore suggest a large communication gap between local government officials and flood-prone communities. Furthermore, since general warning messages are disseminated to the public through a range of forms of media, the quality and quantity of flood-risk information received by flood-affected residents varies. In particularly, it varies according to their access to communication technology (television, radio or internet) and social networks.

In the study, respondents also reported that they have developed their own means of self-communication around severe weather conditions and flooding. These include personal observations of environmental flood cues and personal 'feelings'. This converges with literature by Parker and Handmer (1998) and Parker *et al* (2009), suggesting the use of unofficial warnings is due to the lack of official warning instrumentation among communities exposed to frequently and naturally occurring hazards. Sharma (2003) noted that unofficial warnings based on onsite observations generate tight response margins, thereby reducing the opportunity to save household property and assets. However, this may not be the case for flood-affected households exposed to slow-rising floods.

6.3 The Realised Experience of Rising Floods in Informal Settlements

6.3.1 Informal settlement floods

Rising floods occur annually in the CoCT, primarily during the winter rainfall months (May – August), as reflected in the flood records in appendix 2. Since Kosovo and Masiphumelele are both located on or adjacent to marshy wetland areas, flooding is of a slow-rising nature, saturating the soil as the high water table rises and breaches the ground surface. This results in upwelling and ponding of water. This type of rising flood is consistent with flood processes and conditions in the CoCT's informal settlements profiled in section 3.3.3 of this paper.

Respondents indicate that upwelling occurs inside dwelling structures, as they lack necessary foundations and the ground on which they are located is not stabilised. This is further exacerbated by sunken floor levels, observed by the researcher, inside dwellings to create more space inside. In addition, respondents indicated that the combination of heavy rainfall and blocked drains, due to indiscriminate dumping of waste, results in overland flow of water and worsening of flood conditions. Research findings also show that poor building materials, used by flood-affected respondents to construct dwellings, encourage water seepage and roof leaks, which contribute to flood conditions.

Research findings indicate that respondents from both settlements had experienced at least one flood event, and were therefore aware of the threat of rising floods. Although respondents did not perceive rising floods in Kosovo and Masiphumelele as life-threatening, findings indicate concern for household assets and property.

6.3.2 Flood preparedness and response adjustment strategies

According to the study's findings, only minor adjustments were made by respondents to cope with the immediate effects of rising floods. Respondents explained that adjustments were made largely to ensure the dwelling structure and household assets were not damaged by flood waters. This is consistent with Krep's (1984) suggestion that people who do not perceive the severity of a threat as significantly life-threatening, will absorb impacts of extreme events with little or no premeditated action. He suggested that only creative adjustments are relied upon to meet short and long term

needs, which in this case is the need to protect assets and property. This means that the flood-risk, from the perspective of informal settlement respondents, is the probability of damage to assets.

This is further underlined by behaviour of flood-prone respondents in response to appeals to evacuate to temporary flood shelters. Many respondents in this study maintained that they chose to stay at home to protect their household from looting and theft. In the findings of this study, the respondents rated the risk of asset loss due to theft (if they evacuated) as more important than the risk of temporary flood-induced hardship (if they remained at home). Furthermore, poor conditions in temporary flood shelters discouraged their use. These observations are consistent with common evacuation behaviour in the literature by Fischer (1998), Chowdhury *et al* (1993) and Haque and Blair (1992), on the priority over household possessions, and the negative experiences of flood-victims in the use of temporary shelters, by Chowdhury *et al* (1993).

6.3.3 Attitudes and behaviour in response to rising flood-risk

Research findings indicate that the overall risk governance approach of the CoCT has implications for how people perceive and respond to rising flood-risk and flood warnings (represented in the right hand quadrant of the conceptual framework on page 92). An advantage of the conceptual framework used for this study is that it allows for the identification of both converging and diverging attitudes and behaviour of flood-affected respondents and City Officials, which is detailed below.

Behaviour in response to flood effects

Ironically, study findings indicate converging opinions between informal settlement residents and local government officials. For instance, flood-affected respondents and City Officials interviewed indicated use of short-term response measures to manage the immediate effects of flooding, thereby catering for the short-term needs of flood-affected households. These included creative adjustments described by household respondents to reduce the impact of flooding, and the winter flood preparedness activities and flood relief programme activated by local government officials each year. The behaviour of informal residents is consistent with De Marchi's (2003) findings, which suggest that people with insecure land tenure are less likely to invest in long-term risk reduction measures against potential hazards.

Attitude towards flood-risk communication and management measures

Further convergence of opinions by both flood-risk communication groups was identified by the study relating to the effectiveness of 'flood protection' brochures. Both groups were of the opinion that flood-risk communication and management measures were sub-optimal. For instance, respondents either claimed they had never received brochures before, or had found brochures 'irrelevant' as they did not address the needs and priorities of flood-affected respondents. City Officials interviewed also pointed to the failure of these brochures in addressing issues relating to flood-risk in informal settlements.

However, findings also underlined polarised views on the locus of responsibility for seasonal flood-risk management measures. Household respondents were of the opinion that it is the responsibility of local government officials to manage and respond to flood-risk. CoCT Officials though, indicated that the CoCT's approach to managing flood-risk in informal settlements is to foster an attitude of self-reliance among flood-prone residents. Due to the contradictory nature of these perspectives, the impacts of floods are felt by both stakeholders year after year, as residents are recurrently affected by floods, and officials continuously respond to flood events.

Convergence of long-term flood-risk management perspectives

In this study, both household respondents and City Officials interviewed were of the opinion that the long-term solution to flooding in informal settlements would be provision of low-cost informal houses. City Officials interviewed argued that informal settlements should not exist in areas like Masiphumelele and Kosovo in the first place, as they encourage occupation of ecologically sensitive areas prone to natural flooding. An ideal solution posed by City Officials is the relocation of informal residents away from ecologically sensitive areas, to safer low-cost formal houses.

Similarly, the aspiration of many of the informal settlement residents interviewed was to relocate to low-cost formal houses. Since housing is a major priority, respondents intimated that flood-affected residents deliberately build their dwellings in high flood-risk areas like Masiphumelele and Kosovo. Respondents explained that this is done due to an (incorrect) perception that if severely affected by floods, they will be provided with a formal house. This type of opportunistic risk-taking behaviour is a result of misguided past housing initiatives by the government, partly in an attempt to overcome the socio-economic disparities of the apartheid regime. The slow-rising nature of floods, which pose

little threat to the lives of informal residents, and the prioritisation of flood-risk management by local government during the winter months, provides a platform for this type of risk-taking behaviour.

Risk-taking behaviour of this nature may be considered a unique scenario in the risk context of the CoCT. Although in-depth analysis of the literature was undertaken, no behaviour of this type was identified in other countries or regions. The only type of risk-taking behaviour (or inaction) identified in the literature was behaviour relating to dependence on state welfare, presented by Parker et al (2009) and Parker (2008). In these contexts, passive non-responsive behaviour is believed to increase levels of risk as people believe they will be physically and financially rescued by authorities. Within the CoCT's context, flood-prone residents actively respond to flooding by increasing their risk of flooding, to ensure receipt of a formal house.

6.4 Risk Governance Challenges in Implementing People-Centred Early Warnings for Rising Floods in Informal Settlements

6.4.1 Overview

Research findings and the preceding discussion above, identified various challenges in meeting the requirements of all the elements necessary for developing and implementing PCEWS for rising floods in informal settlements. They also foreground the shortcomings in current approaches to conceptualising informal settlement flood-risk. Similarly, they underline the immense challenge facing the CoCT in minimum service provision requirements, for a large urban population living in informal settlements, within a resource constrained environment. These challenges are not only underpinned by resource constraints, but by a political imperative for basic service delivery to all accessible informal settlements. The risk communication model adapted for this study, in figure 32, was instrumental in highlighting the key challenges and constraints for people-centred approaches to rising flood early warnings in the CoCT.

6.4.2 Conceptualisation of urban flood-risk and flood warnings

Globally, characteristics of a flood hazard and elements of exposure have been used to conceptualise conventional flood EWS. In particular, prevailing conceptualisations of flood-risk have been primarily driven by conditions of exposure over riverine catchment conditions. Since the

literature frequently refers to fatalities and widespread flood damages of people and economic assets located in river floodplains, such as in Bangladesh (Chowdhury *et al*, 1993 ; De Marchi, 2003; Schmuck, 2000), much emphasis has been placed on characteristics of river catchments in the design of flood EWS. These include location in a river catchment, depth, duration and velocity (Parker, 2008; Phaiju *et al*, 2010). Consequently, 'conventional' flood EWS have evolved as a vehicle to protect individuals who are physically exposed to riverine floods and whose lives may be at-risk.

However, this study's findings profile exposures associated with urban slow-rising floods, which diverges significantly from popular literature on flood-risk and flood early warnings. Much of the literature by Parker, Abromovitz, Zschau and Kuppers and Schmuck, to name a few, focuses on riverine or flash flooding which are perceived by officials and flood-prone communities as life-threatening. Slow-rising floods have quite different causal chains and consequences for those exposed to them, than those living in flood-risk contexts underpinned by riverine flooding. Flood EWS centred on the protection of human lives therefore become less relevant in informal settlements such as Masiphumelele and Kosovo.

The findings therefore foreground key questions about the 'wholesale' transfer of flood EWS approaches centred on the protection of human lives. For instance, the examples of PCEWS provided in this study, in the Philippines and in Bangladesh, have been developed according to the risk context and needs that are locally defined, and cannot necessarily be replicated everywhere. Essentially, globally developed flood EWS approaches cannot be implemented without being nuanced to specific risk contexts, such as those found in Kosovo and Masiphumelele, where the probability of flood-risk is the damage to property and assets.

Within the CoCT the selection criteria for assessing flood-risk includes location, environmental processes and sensitivities and prevailing winter weather conditions. This approach to flood-risk indicates a hazard-oriented style of assessing and managing floods.

Urban flood-risk in the CoCT has therefore been conceptualised in different ways by the different government structures, and at the settlement level. The study's findings indicate that flood-risk is socially constructed by flood-affected residents, through the prioritisation of assets and property by informal residents, based on past experiences and observations of flood events. In addition flood-risk is driven by prevailing conditions of vulnerability, such as sunken floors inside informal dwellings. Various government structures, due to a range of constraints and choices conceptualise flood-risk

from a hazard perspective, focusing primarily on conditions of exposure and relying on technical solutions to reduce the impact of a flood hazard.

Therefore, the generic application of EWS in the CoCT does not consider the urban flood-risk context of informal settlements in its entirety, nor is it informed by the co-production of flood-risk knowledge between all communication stakeholders. A simple decisionistic approach to communicating risk is employed, where flood-risk information is disseminated in a uni-directional manner from an 'authority' to the 'public' as a whole.

The research findings therefore call for coherence between flood-risk and flood management, to ensure better alignment between the type of flood EWS and the local risk context.

6.4.3 The City of Cape Town's rudimentary service provision model

Research findings show that the CoCT is 'doing the best it can' to manage flood-risk, with the limited resources and capacity at their disposal. The sheer scale of the flood-risk problem at the metro-level requires the application of a decisionistic risk governance model to ensure at least marginal benefits of reduced flood losses, given prevailing resource constraints. Thus, even though the services provided by the CoCT are rudimentary in nature, it is important to note that they have succeeded in significantly reducing the number of flood-affected individuals and households in informal settlements over the past decade. Much of the reduction in flood loss is attributed to the significant coverage of provision of services by the CoCT's Department of Roads and Stormwater, through pro-active cleansing operations and drainage system implementation and upgrades.

In this context, it is possible to interpret the level of service related EWS for severe weather events in the CoCT, as rudimentary. Although not optimal, it is however consistent with the CoCT's service delivery model of providing basic services over a wide range of informal settlements. The primary concern of flood early warnings in the CoCT is to disseminate severe weather and flood-risk information to as many people as possible in the most effective, affordable and equitable manner, given prevailing resource constraints.

While an optimal approach to flood EWS would be a commitment to support all four elements of PCEWS, and a multi-directional approach to communication, as illustrated in the conceptual

framework in figure 32, this inclusive approach falls beyond the scope of the rudimentary service delivery model, given prevailing resource constraints.

6.4.4 Opportunistic risk-taking behaviour

Household respondents in this study explained that informal residents, living in flood-affected areas like Masiphumelele and Kosovo, believed that if they were severely affected by a flood event, the likelihood of being provided with a low-cost formal house would increase. This behaviour is facilitated by the nature of non-threatening slow-rising floods in informal settlements, and the prioritisation of flood-risk by local government during the winter rainfall months.

This opportunistic behaviour may have adverse implications for the implementation of a flood early warning system. Flood EWS within this context may actually trigger or increase risk-taking behaviour of informal residents seeking to further their own interests. Thus, flood-prone residents would expose themselves further to the risk of flooding, which would put additional strain on the CoCT's flood-risk management and response capacity and resources.

6.5 Implications of Findings for Future People-Centred Flood Early Warnings

This study has highlighted the numerous challenges of developing and implementing PCEWS in flood-prone areas such as Kosovo and Masiphumelele informal settlements. This section seeks to address these challenges by suggesting the requirements necessary to strengthen the robustness of flood risk management, specifically in terms of future people-centred flood EWS, in the CoCT.

<u>International Best Practice</u>

With regards to people-centred early warnings, it is important to follow international best practices that will ensure that flood-risk management approaches are kept abreast of contemporary knowledge, approaches and methods for managing flood-risk. Examples have been provided within this study of how flood EWS have been improved in areas such as Bangladesh and the Philippines through the co-production of indigenous and scientific knowledge in all key elements of PCEWS. Through close consultation and participation with local flood-prone communities, collective decision making throughout the development and implementation of EWS was achieved, which ensured the

successful uptake and use of local flood EWS, as well as the empowerment of the communities involved.

Caution however must be exercised to ensure the wholesale of approaches from other countries or areas does not take place. Instead, risk contexts must be robustly interrogated to ensure approaches are adapted to, yet tailor-made for, specific and or unique risk contexts. Caution also needs to be heeded in the term **International Best Practice**, as it may not necessarily be a best practice in all contexts internationally. For instance, PCEWS developed in Bangladesh are developed for a specific risk context, and may not be as successful in areas such as Kosovo or Masiphumelele.

For instance, due to the life-threatening nature of riverine flooding in Bangladesh, flood-prone communities are more willing and quicker to act and work together, with authorities, to reduce the threat of flooding. This type of threat is different from the slow rising floods experienced in Kosovo and Masiphumelele, affecting urban populations with inherent political and social complexities. These characteristics affect the level of community cohesiveness, and a community's ability to trust and work with authorities. Moreover, the overall risk governance context in Bangladesh, and the resources available made for a more conducive environment for genuine community engagement and the resultant people-centred approaches to EWS, compared with a more constrained risk governance approach in the CoCT. As a result, different and more nuanced approaches are required for developing and implementing EWS in different risk contexts.

Transparent Risk Governance

The necessary pre-condition for PCEWS is transparent risk governance. Therefore, for a more nuanced approach to EWS at the local scale, greater participation and engagement, and collective decision-making between the various risk communication stakeholders is required. Furthermore, CoCT Officials will be required to move away from hazard-focused interventions, to those considering both elements comprising risk, namely conditions of vulnerability and the hazard. Community engagement guidelines for all government structures are required to ensure uniform and appropriate consultation and participation with people living in flood-prone areas, ensuring use of indigenous knowledge, collective decision making and local capacity. The inclusion of flood-prone communities in the management of flood-risk should be viewed as a means of improving final decision-making, rather than impeding or compromising the decision-making process.

Through a transparent risk governance approach, a greater understanding will be acquired of the level of flood-risk that community members are prepared to pursue, retain or take, and what levels of loss stakeholders are prepared to accept. This will ensure appropriate risk management strategies are implemented that take into account and counteract risk taking behaviour.

In the context of a more transparent risk governance approach, people-centred EWS will be made more possible, centring on the needs of those living in flood-prone areas. Since poor informal settlement households value their assets and will make creative adjustments to protect them during a flood event, flood EWS centred on these needs may be successful and applicable.

In the CoCT, all these will largely be solved through greater access to resources and capacities, solid political commitment, laws and regulations, durable institutional capacities, interactive community engagement, and a commitment to long-term flood-risk reduction, rather than the continuous focus on short-term solutions.

6.6 Conclusion

The aim of this study was to examine the feasibility of flood early warnings for informal settlements in the CoCT, by placing particular emphasis on the experiences of flood-affected residents of Kosovo and Masiphumelele informal settlements. Through the application of a risk communication framework, developed for this study, the experiences of flood-risk communication stakeholders, and flood-risk management processes were explored and examined. These flood-risk experiences and processes assisted in the identification of the risk communication model used in the CoCT, which in itself assisted in identifying the prevailing risk governance approach of the CoCT. Through this process, and the greater understanding of the risk governance approach and risk communication model, the study was able to determine the feasibility of developing people-centred flood early warnings at the local scale in the CoCT's informal settlements.

The findings of this study suggest that due to a number of challenges in committing to, and ensuring the interaction of the elements of PCEWS, highlighted by the conceptual framework for this study, future people-centred approaches to flood EWS may be considered impossible or impractical for flood-affected informal settlements in the CoCT.

The challenges influencing the success of these people-centred EWS include the CoCT's prevailing risk governance approach, which fails to facilitate meaningful participation and collaborative decision-making between all risk communication stakeholders. This is reflected by findings that indicate a uni-directional communication of risk information, which is not consistent with the risk communication framework for this study.

In addition, because of the specific nature of the slow-rising flood hazard, affected individuals rarely perceive flooding as life-threatening. This makes flood EWS centred on the protection of lives illogical and less effective. Furthermore, conventionally conceptualised flood EWS may inadvertently increase risk-taking behaviour if implemented in settlements exposed to slow-rising floods, due to prevailing perceptions of receiving a low-cost formal house if severely impacted by a flood.

The necessary pre-condition for PCEWS is transparent risk governance. In the CoCT, this will largely be made possible through greater access to resources and capacities, and a commitment to long-term risk reduction, rather than the focus on short-term hazard focused solutions.

A greater understanding is required of the level of flood-risk that flood-prone community members are prepared to pursue, retain or take, and what levels of loss stakeholders are prepared to accept, to ensure appropriate risk management strategies are implemented.

Given a transparent risk governance approach, people-centred EWS may be more successful if centred on flood-prone residents' need to protect household assets from slow rising flood hazards.

Evidence based on the findings of this study indicates that a decisionistic risk governance model at a metro-scale is effective in addressing the level of the flood-risk problem in the CoCT. It ensures the successful reduction of flood losses through the delivery of basic services over a range of informal settlements. In this context, the CoCT is able to provide an accessible, affordable flood early warning service at a metro-scale to a range of flood-affected individuals, households and communities.

Although this governance approach may be effective under the circumstances mentioned above, it has shortcomings when applied on a local scale. To this extent the approach is not sufficiently nuanced to cater for specific flood-risk issues at that scale. The fallback lies in the difficulty in designing and implementing appropriate flood EWS, specifically using contemporary people-centred

approaches. This being a fundamental aspect in developing EWS for informal settlements such as Masiphumelele and Kosovo.

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APPENDICES

Appendix 1: South African national progression of thought and legislative change in approaches to managing disaster risk

In South Africa, three major shifts in the thinking around the safety of civil society have occurred (Van Niekerk, 2005). The first began in 1966 with the promulgation of the Civil Defence Act 39 of 1966, and the institution of a Directorate Civil Defence, which remained a function of national government (Ibid). Due to inherent weaknesses, the Civil Defence Act was revoked and replaced by the Civil Protection Act 67 of 1977, which promoted civil defence at all levels of government (Ibid). By 1990 all references to civil defence were revised to read 'civil protection' to acknowledge growing awareness that disaster impacts could be minimised through the introduction of preparedness programmes, particularly at the local level (Ibid).

Eventually the destructive floods on the Cape Flats in June of 1994 highlighted the inadequacies of the Civil Protection Act and profiled the urgency for legislature reform within the disaster management realm (South Africa, 2005). The floods acted as a catalyst in the final paradigm shift that resulted in the promulgation of the National Disaster Management Act (NDMA) 57 of 2002 on the 15th of January 2003 (Ibid; Van Niekerk, 2005). The new act ensures approaches to disaster management are holistic and closely linked to developmental initiatives at all levels of government (Van Niekerk, 2005).

The National Disaster Management Framework (NDMF) was published in May of 2005 as a legal instrument to ensure consistency across multiple interest groups through a transparent and inclusive policy on disaster management (South Africa, 2005). The NDMF comprises four key performance areas (KPAs) and three enablers responsible for achieving the objectives outlined in the KPAs (Ibid).

Appendix 2: Flood records for the City of Cape Town, sourced from DRMC's flood records and incident logs

Table 1: Floods reported for the Cape Peninsula affecting informal settlements for years 1994 – 2005

DATE	DISASTER DECLARATION	EVACUATED	STRUCTURES	FLOOD VICTIMS	SHELTER	PERSONS SHELTERED	FOOD PARCEL	MEALS	BLANKETS	MATTRESSES	STARTER KITS	SAND TRUCK
1994/05/26-27	N		?	1000								
1994/06/15-20	Y	400	8000	30000								
1994/06/26-27	N	20	1000	10000								
1994/07/22-25	N	3000	100000	250000			3000 RC		1000 RC			
1994/08/18-19	N	40	10	3000								
1995/06/08-09	N	300	500	3000								
1997/06/22 24	N		2000	30000			2000 RC		600 RC			
1997/06/26-28	N		1000	10000			1000 RC		200 RC			
1999/09/11-12	N	400	2000	5000				3000 RC	800 RC; DM			50
2004/08/05-11	N	21000	6000	100000	7 X Halls	1278	191 HDI	199650 HDI; M; SANZ; RC	14881 HDI; M; SANZF; RC	177	1015 CCT	30
2005/08/17-21	N	300	2000						1000 HDI		400 CCT	60
2005/08/26-30	N	500	1000	5000				1500 HDI	500 HDI		400 CCT	60

[RC – Red Cross; M = Mustadafin; HDI = ; SANZF = ; CCT = CoCT Housing]

Table 2: Floods reported for Cape Town affecting informal settlements for the years 2001 - 2005

ATE	DISASTER DECLARATION	EVACUATED	STRUCTURES	FLOOD VICTIMS	SHELTER	PERSONS SHELTERED	FOOD PARCEL	MEALS	BLANKETS	STARTER KITS
2001/07/04-24	Y		668	3860	Community Centres	3800				
2004/04/16	N	200	1400	5000						400 CCT
2005/4/10-11	N	4400	545	4400				12800 HDI; RC	3760 HDI; RC	500 CCT
2005/6/7 8	N	500	1100	5000	Lost City Community Hall	500		15600 HID; RC	6200 HDI	600 CCT
2005/6/14-20	N	200	2325	6883			100 HDI		2598 HDI; SANZF; M; RC	2142 CCT

Appendix 3: Key challenges posed by housing and tenure and service delivery in informal settlements in the CoCT

Housing and Tenure

An essential basic human right protected by the South African constitution is adequate formal housing (DAG, 2006). However, partly due to our colonial and apartheid legacy, the majority of South African citizens live in unhealthy and unsafe conditions where they lack access to basic services (Ibid). Furthermore, the highly unequal land market as a result of the 1913 Land Act and the Group Areas Act, has not allowed opportunity for the participation of the poor, thereby contributing towards poverty, inequality and landlessness (Ibid).

According to Cross (2006), South Africa's demography of urbanisation is becoming a race for housing. In 2009 in the CoCT alone, there were 300 000 applicants on the housing database, and approximately 100 000 others requiring housing not even registered yet (Malnick and Bramford, 2009). However, according to Bouchard *et al* (2007), the national and provincial governments provides the CoCT only enough subsidies to provide for between 6 000 and 7 000 housing opportunities per year, a far cry from meeting the growing demand for housing (Ibid). Consequently, urbanisation is increasingly taking the form of informality, with tenure insecurity a central characteristic of informal settlements, featuring unsanitary and hazardous living conditions, overcrowding and lack of basic services (DAG, 2006; Huchzermeyer *et al*, 2006).

Ideally, the CoCT would prefer to relocate the 120 000 or so dwellings located in informal settlements to areas not prone to flooding (Bouchard *et al*, 2007). However due to lack of funding and housing subsidies and continuous urbanisation, it is an impossible task to accommodate every informal resident with a formal house (Ibid). In addition, the CoCT must allocate funding to aid in the relief of disaster victims affected by hazards such as floods and fire in growing informal settlements, with the assistance of volunteer agencies (Ibid).

Institutional shortcomings in local governance (Cross, 2006), inadequate subsidised housing, constant in-migration of families, and the demands and needs of informal residents maintain a threat of conflict between informal residents and local government. Realised conflict over access to benefits of housing and services delivery has often erupted in low income communities in South Africa (Ibid). Street protests often follow a flood or fire disaster with informal residents protesting

over the paralysis in the provision of promised housing and service delivery (Ibid). For example, in June 2007, residents of Philippi burnt tyres and threw rubbish bins and bucket toilets in streets, demanding to be moved to other vacant land as their informal settlement has been flooded following heavy rains (Bouchard, 2007). The images below illustrate service delivery protests in Masiphumelele in August of 2010.

(Source: www.iol.co.za)

Service Delivery

The South African Government have, since 1994, attempted to eliminate informal settlements by relocating residents to formal housing (Graham, 2006). However, officials of the Western Cape soon realised that provision of subsidised formal housing cannot eliminate the housing backlog or do away with informal settlements in the CoCT (Ibid). Since informal settlement residents and communities need access to shelter, services, essential social facilities and income generating opportunities (Smit, 2006), in 2005 the first Informal Settlement Upgrading Programme in South Africa was announced for the problem of growing informal settlements (DAG, 2006). The new programme argues the maximisation of what is already in place, building on the creativity and capital investment of poor communities and the importance of increasing people's sense of belonging and ownership (Ibid).

According to Smit (2006), servicing of informal settlements includes the provision of rudimentary services such as one toilet for every four or five households, communal standpipes within 200m of all dwellings and fire hydrants within 150m of all dwellings. For those settlements considered suitable for further upgrading, stabilised earth roads, lined stormwater drainage channels and area lighting is provided (Ibid).

Unfortunately though, officials of the CoCT have faced challenges in interpreting and implementing the new informal settlement upgrading policy, particularly due to the lack of a suitable policy instrument and political opposition (DAG, 2006; Graham, 2006). As a result, the CoCT has generally undertaken ad hoc servicing initiatives, largely in response to frequent informal settlement fires and flooding (Graham, 2006).

In particular, political pressure has undermined the delivery of services in informal settlements. On the 26th of May 2004, the CoCT Mayor pledged that all informal settlements in the CoCT would be serviced by 30 June 2004 (Graham, 2006). This announcement was made without consulting officials responsible for service implementation and delivery, and due to the small time frame provided, officials were unable to consult with communities living in informal settlements (Ibid). Official provided absolute basic minimum level of service to over 90% of accessible settlements (Ibid). In the process, officials faced many challenges including accessing resources and conflict between officials and communities over levels of service and location of services, largely due to lack of consultation (Ibid).

Appendix 4: Details for severe weather early warning systems in the CoCT

Early Warning Categories for Severe Weather Events

Early warnings for severe weather events are divided up into categories according to the timing, and level of preparedness measures one is required to take in response to a potential hazard. Categories include an 'Advisory', 'Watch' and 'Warning', outlined in table 3. Accompanying an alert category is a colour coded system that indicates the alert levels of the various early warning categories, and is intended for graphical displays on an early warning map of South Africa, refer to table 4. Table 5 lists the lead time requirements for severe weather events and associated colour-coded alert categories.

Table 3: Early Warning Categories

Advisory: Be aware! Provides an early warning of potential hazardous weather in 2 to 6 days period.
Watch: Be prepared! Indicates an alert that weather conditions are likely to deteriorate to hazardous levels, though warning conditions have not yet been reached. Valid in 1 to 3 day period.
Warning: Take action! Warns that hazard is already occurring somewhere, or about to occur with a very high confidence. These are issued for the next 24 hours.
***Tied to the alert category is the forecaster confidence that the particular alert level will occur.*

Table 4: Colour Coding System

COLOUR CODING FOR ALERTS AND RELATED INFORMATION					
	Severe Weather				Extreme Weather
	GREEN	YELLOW	AMBER	RED	RED
Category	No alert	Advisory	Watch	Warning	Extreme Warning
Awareness Level	None expected	Be aware	Be prepared	Take action	Large scale action
Risk	No adverse weather is expected	A risk that adverse weather conditions will occur	Moderate risk that adverse weather conditions will occur	Very high risk, about to happen, or already happening	Very high risk, about to happen, or already happening
Forecaster Confidence	Very low < 20%	Low moderate to high >20% >40%	Low moderate to high >20% >40%	Very high > 80%	High Very High > 60% > 80%
Impact	None	Risk of some damage to infrastructure and	Moderate risk of some damage to infrastructure and	High risk of some damage to infrastructure and	Severe widespread disruption and damage of

		local disruption, dangerous to people and small communities	local disruption, dangerous to people and small communities	local disruption, dangerous to people and small communities	infrastructure, very dangerous to people and small communities
Advice		Be alert and listen to the latest weather forecasts	Be vigilant and listen to the latest weather forecasts	Be extra vigilant of dangerous conditions and listen to advice given by authorities	Be extra vigilant of dangerous conditions and listen to advice given by authorities

Table 5: Lead Times of Early Warnings

Type of Alert	Lead Time	Alert Category		
Severe Weather, Extreme Weather	> 3 days	Nil	Advisory	
Severe Weather, Extreme Weather, Veld Fire, Flash Flood, Maritime	2-3 days	Nil	Advisory	Watch
Severe Weather, Extreme Weather, Thunderstorm, Veld Fire, Flash Floods, Maritime, Aviation	24 hours	Nil	Watch	Warning

Flood Early Warning Transmission Procedure

In the case of an approaching severe weather event SAWS send a short concise group sms and or email, containing severe weather early warning information to senior management of CoCT DRMC, the TOC, DOC, Roads and Stormwater Department and other relevant role players. The message is then relayed to response staff involved in the Flooding and Storms Plan. This ensures disaster response teams are on standby city-wide for activation, ready to be deployed to support disaster response and recovery operations. The dissemination of early warnings via sms is considered too expensive, and therefore impractical for public dissemination.

Upon receipt of a severe weather early warning the DRMC issues a press release containing early warning and other relevant information to daily newspapers. The CoCT radio stations then pick up the information from the press releases published in newspapers and contact the DRMC for interviews. Additionally, the DRMC sends early warnings and other weather related information via emails on a weekly basis to all major city services and NGOs.

DRMC field officials rarely communicate severe weather warnings, received via sms from SAWS, directly to informal settlements, largely due to lack of infrastructure, mechanisms and support necessary to accompany EWS.

The media is considered the most effective distributive force for severe weather early warnings. The dissemination of warnings is done primarily through several media types, including newspapers (print), radio broadcasts and telephonic recordings (audio), and television and internet (visual).

The Construct of an Early Warning Message

According to the CoCT regional weather forecasting office, a standardised reference list of the correct and recommended wording is used for each type of severe weather warning. With regards to the structure of an early warning message, SAWS follow the general structure outlined by the World Meteorological Organisation (WMO), which includes those outlined in Table 6.

Table 6: Key components of an early warning message

Type of Warning	Advisory, watch or warning
Where	Identifies areas that are at risk
When	Identifies onset period, duration and when it will be over
What to do	Suggest small things one can do to lessen effects of hazard where possible

With regards to the third requirement of an early warning message, 'what to do', in the current early warning system, appropriate actions accompanying a message is considerably lacking.

Appendix 5: Semi-structured Household Questionnaire

GENERAL PARTICULARS OF THE RESPONDENT

1. AGE: _____
2. MALE: ☐ FEMALE: ☐
3. HOME LANGUAGE: _____
4. IF LANGUAGE IS NOT ENGLISH: Do you understand English?

   YES ☐ NO ☐

   Can you read in XHOSA or ENGLISH (Circle one or both)
5. HIGHEST LEVEL OF EDUCATION:_____
6. WHEN DID YOU MOVE TO KOSOVO? _____
7. WHY DID YOU MOVE TO KOSOVO_____
8. STRUCTURE OF HOUSE: Identify material used for:

   Roof: _____

   Wall: _____

   Floor: _____
9. DO YOU OWN THE FOLLOWING?

   TV ☐ MOBILE PHONE ☐ RADIO ☐
10. IS THE HOUSEHOLD FLOOR **BELOW** OR **ABOVE** GROUND LEVEL? (Circle Answer)

    If below, ask WHY _____

RISK UNDERSTANDING AND MANAGEMENT

11.

What bad weather conditions affect you most?	How do they affect you?

12. WHICH OF THE FOLLOWING ACTIONS DO YOU TAKE TO PREPARE FOR COMING RAIN, WIND AND FLOODS?
    - o Move to higher ground ☐ _____
    - o Raise your floor to above ground level ☐ _____
    - o Put cement on floors ☐ _____

- Dig trenches around your house ☐ _____
- Surround house with sandbags ☐ _____
- Clear stormwater drains ☐ _____
- Waterproof roofs ☐ _____
- Secure house against the wind ☐ _____
- Stay with friends and family ☐ _____
- Stay in a temporary shelter (community hall) ☐ _____
- Other _____

13. HAVE YOU EVER BEEN FORCED TO MOVE OUT OF YOUR HOUSE DURING AND OR AFTER HEAVY RAINS/FLOODS? YES ☐ NO ☐
14. IF 'YES', WHERE DID YOU GO?
    Friends ☐ Family ☐ Community Hall ☐ Other ☐ _____
15. IF NO, WHAT WERE THE REASONS FOR NOT NEEDING OR WANTING TO GO TO A PLACE OF SHELTER? _____
    _____
16. WHY DO YOU BELIEVE YOU ARE AT RISK TO BAD WEATHER?
    _____
    _____

WEATHER WARNINGS:

17. DO YOU KNOW WHAT AN EARLY WARNING IS? (Isilumkiso semoyezulu?)
    _____
    _____
18. HOW DO YOU HEAR ABOUT BAD WEATHER OR REALISE THERE IS GOING TO BE BAD WEATHER? Look out for indigenous knowledge, how people are sensitive to change.
    _____
    _____
19. IF YOU NEED INFORMATION ABOUT DANGEROUS WEATHER AND FLOODING, WHO DO YOU CONTACT? _____
    HOW? _____
    AND FOR WHAT? _____

20. DO YOU THINK BETTER EARLY WARNINGS AND PREPAREDNESS ACTIONS ARE NEEDED FOR KOSOVO? _____

21. IF YES, WHAT DO YOU RECOMMEND AND FROM WHOM? _____

_____

_____